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WATER and RELATED LAND RESOURCES
HUMBOLDT RIVER BASIN
NEVADA

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REPORT NUMBER THREE
RUBY MOUNTAINS SUB-BASIN
MAY, 1963

Based on a Cooperative Survey
by
THE NEVADA DEPARTMENT OF CONSERVATION AND NATURAL RESOURCES
and THE UNITED STATES DEPARTMENT OF AGRICULTURE

Economic Research Service - Forest Service - Soil Conservation Service

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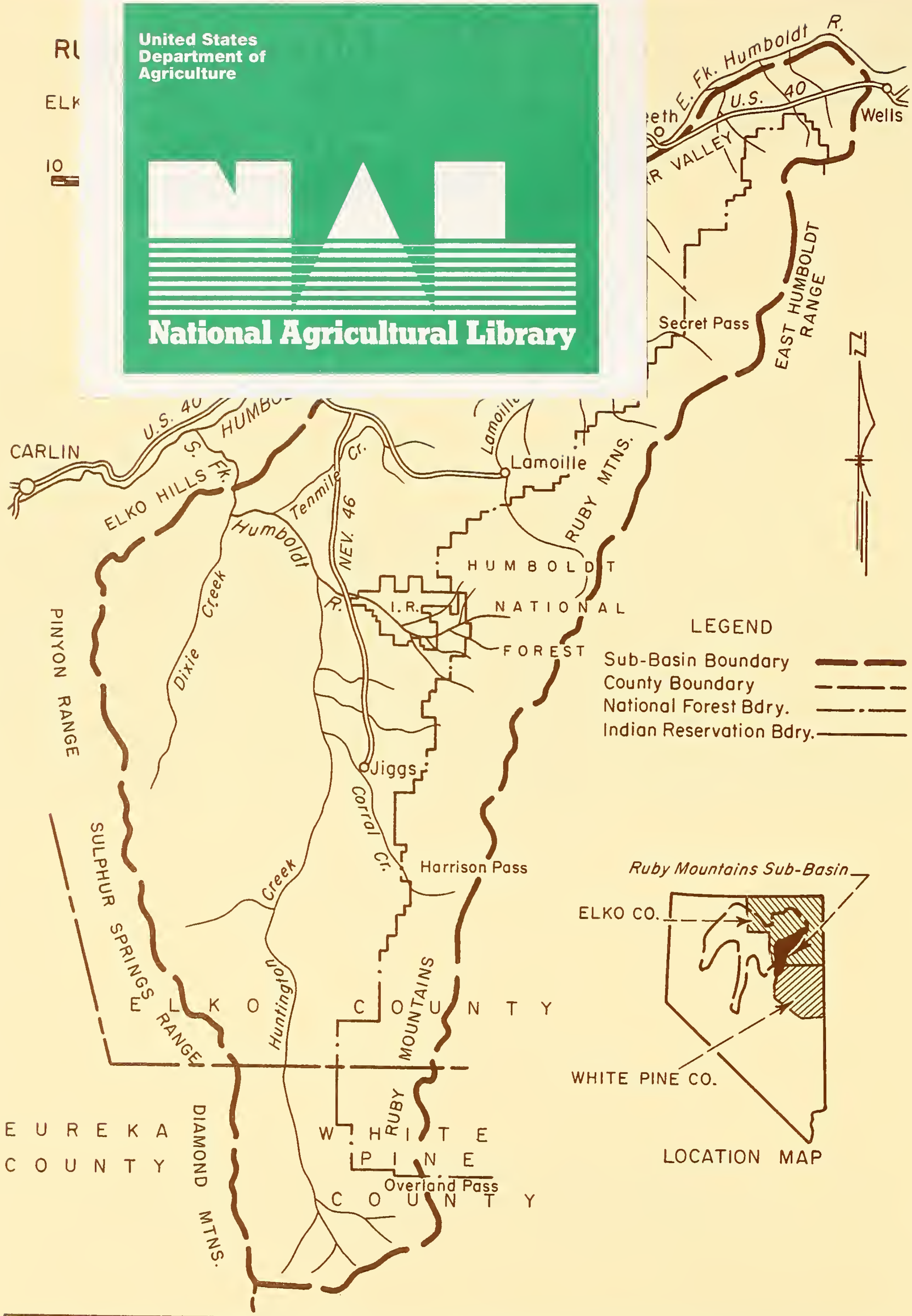

COVER PHOTOGRAPH - *Looking easterly across middle Lamoille Valley, with snow-capped Ruby Mountains in background. Petersen Ranch headquarters buildings in middle distance, to the right.*

SCS PHOTO---6-572-5

USDA-SCS-PORTLAND OREG. 1963

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HUMBOLDT RIVER BASIN SURVEY

RUBY MOUNTAINS SUB-BASIN REPORT

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ORGANIZATION OF REPORT

The report on the Ruby Mountains Sub-Basin is divided into three main sections. The first section is an overall report on the sub-basin; the remaining two sections consist of Appendix I and Appendix II, respectively.

Appendix I is attached to all the report copies, and contains pertinent material concerning the sub-basin which is of value to the general reader.

Appendix II is produced in a relatively limited number of copies. Its small appeal to the general reader renders it unsuitable for inclusion with the report copies for general distribution. However, this type of material does have potential value as an information reservoir for technicians, administrators, and resource managers concerned with the Ruby Mountains Sub-Basin. Copies of this appendix are available upon request.

FOREWORD

This is a report for the people of Nevada, and particularly for the people of the Humboldt River Basin, concerning water and related land resources in the Ruby Mountains Sub-Basin. It is the third of a series of reports which will result from a cooperative survey of the Humboldt River Basin by the Nevada State Department of Conservation and Natural Resources and the U.S. Department of Agriculture. It was prepared by the Soil Conservation Service and the Forest Service of the Department of Agriculture.

The State of Nevada seeks constantly to assist local people and their organizations in the conservation, development and management of water resources. It has particular regard for the relationship of water to land and to human resources. This is exemplified by the creation of the Nevada State Department of Conservation and Natural Resources. A primary responsibility of that Department is to cooperate with Federal agencies and local groups and to coordinate State-Federal activities that help solve water and related land problems for the people of Nevada.

The responsibilities of the Nevada State Department of Conservation and Natural Resources, and the cooperative research work already under way in the Humboldt River, set the stage for Federal-State cooperation in developing information on opportunities for improving the use of the land and water resources of the Basin. Accordingly, cooperation was initiated with the U.S. Department of Agriculture under a Plan of Work dated June 3, 1960 with agencies of the Department and of the State of Nevada participating in the survey. It is important here to point out that responsibility for matters concerning State water rights and determination of water supply as it might affect State water rights was assumed by the State of Nevada.

This survey of the Humboldt River Basin is for the primary purpose of determining where improvements in the use of water and related land resources, some of which have social and economic aspects, might be made with the assistance of projects and programs of the U. S. Department of Agriculture. A major part of the survey is focused on situations where improvement might be brought about by means of Federal-State-local cooperative projects developed under the Watershed Protection and Flood Prevention Act (Public Law 566, 83d Congress as amended). This cooperative survey is in keeping with long established tradition in the Department of Agriculture of cooperation with states and local entities in the conduct of its work. Further, such cooperation is a most important responsibility of the Nevada State Department of Conservation and Natural Resources.

The U.S. Department of Agriculture-State of Nevada Plan of Work in the Humboldt River Basin offers opportunities for participating in the survey by other Nevada State agencies and Federal agencies. The Bureau of Land Management, as an example, has cooperated with respect to the national land reserve. Thus, the survey is not limited but is rather as broad in scope and agency participation as is required to meet the agreed upon objectives.

The entire Humboldt River Basin is being studied by segments identified as sub-basins. This report contains much information for study and use in understanding and solving some of the existing water and land resource problems in Starr Valley, Lamoille Valley and South Fork drainages. The report presents opportunities for Federal-State-local project-type developments under the Watershed Protection and Flood Prevention Act, together with other opportunities for development and adjustment.

I wish to recognize the excellent work of the U.S. Department of Agriculture and the Nevada State Department of Conservation and Natural Resources in this cooperative effort. I consider that this report will serve the best interest of the people in the Humboldt River Basin and the State of Nevada.

Grant Sawyer

Governor of Nevada

SUMMARY

The Ruby Mountains Sub-Basin comprises the group of watersheds which drains the west slope of the Ruby Mountains, including the East Humboldt Range, and the east slope of the Pinyon, Sulphur Springs and Diamond Ranges and the south slope of the Elko Hills. The area lies mostly in the southwest corner of Elko County, but includes a small acreage in the northwest corner of White Pine County. The total area of the sub-basin approximates 1,876 square miles.

The South Fork of the Humboldt River and its tributaries (Smith Creek, Huntington Creek, Tenmile Creek) drain the southern half of the sub-basin, while Rabbit, Lamoille, Soldier, and Secret Creeks and the East Humboldt streams in Starr Valley drain its northern portions. Elevations within the sub-basin vary from about 5,100 feet where the South Fork emanates from its gorge into the Humboldt reach below Elko to well over 11,000 feet in the Ruby Mountains.

Average annual precipitation ranges from a little over seven inches at the Sadler Ranch to an estimated 45 inches along the Ruby crest in the vicinity of Ruby Dome. The frost-free period is estimated to average 138 days (28 degrees F) in the vicinity of Lamoille.

Sagebrush-grass constitues the predominant cover over much of the sub-basin, giving way to mixed browse and aspen in the canyons of the Ruby and East Humboldt Ranges. Scattered clumps of limber pine, white bark pine, and subalpine fir are found on the north exposures and high basins in these mountains. The pinyon-juniper type is found along the Ruby foothills south of Toyn Creek, and also in the Diamond Mountains. An extensive stand of juniper is found in the broken hills between Dixie Creek and lower Huntington Creek, as well as around Grindstone Mountain and on the Elko Hills.

Surface irrigation water supplies are derived mainly from the Ruby Mountains and the East Humboldt Range snowmelt runoff, May through July. The supplies are supplemented by small amounts of water from wells, springs, and other drainages within the sub-basin. It is estimated that from 60 to 70 percent of the water yield to the Humboldt River above Palisade comes from this sub-basin. The computed gross water yield is about 214,400 acre-feet, based upon an 80 percent frequency flow year.

The acreage of irrigated land and of cropland harvested varies widely from year to year, depending upon precipitation and stream flow. Practically all the irrigated land is used to produce winter feed for livestock. Other crops include small acreages of potatoes, small grains, vegetables, and fruit, primarily for home use.

Determination of water rights was established by the Edwards Decree of 1935 and subsequent permits from the State Engineer's office. In general, the decree provides for a flow of 1.23 c.f.s. per 100 acres of decreed land, or at proportional rates. Water diverted for irrigation is measured where the main ditch enters or

becomes adjacent to the land to be irrigated, and is allocated to users on the basis of priority of right. To satisfy existing water rights, about 36,600 acre-feet more water are required than the watershed yields during an 80 percent frequency year. An estimated 87,700 acre-feet of water are used to produce hay or pasture on about 63,850 acres, and 15,800 acre-feet are used by 18,200 acres of phreatophytic plants. The hay lands and phreatophyte areas are located principally along the stream bottoms, with some irrigated hay lands on high flood plains and terraces.

There is a limited amount of improved irrigation development in the sub-basin, consisting of land leveling, land smoothing, diversion structures, spreader ditches, irrigation wells, and storage reservoirs. Irrigation is principally by a semi-controlled type of wild flooding. Only limited use has been made of corrugation, border, and sprinkler irrigation.

The Army Corps of Engineers is presently concluding a re-evaluation of a reservoir dam at the Hylton site on lower South Fork. This dam was originally authorized by Congress in 1950 as part of the Corps' Humboldt River Project. The purposes of the proposed reservoir are flood control, recreation, irrigation, and sediment storage.

Of the 1,067,900 acres of range land, 711,100 acres (66 percent) are in the low forage production class, 212,600 acres (20 percent) in the medium class, and 144,200 acres (14 percent) in the fairly high production class. Livestock numbers on sub-basin ranches, based on Forest Service permits and Bureau of Land Management licenses for 1963, were estimated at 23,000 cattle and 43,000 sheep. Federal lands provide most of the spring-fall and summer feed required; the Federal and intermingled private rangelands provide approximately six months of feed. The balance of feed is provided by two or three months' grazing on crop aftermath and adjacent dry and irrigated pasture, and three to four months of hay.

Twelve large fires since 1947 have burned a total of 18,430 acres of range and watershed cover. The three largest of these occurred in July 1947.

Since 1890, the earliest year of recorded flood damage in the sub-basin, there have been nine flood years which have caused damage. All of these floods caused considerable damage in the form of watershed erosion, sedimentation of cropland, and stream and gully erosion. They also damaged roads, bridges, and buildings.

From the standpoint of recreation use, this sub-basin is probably the most important in the Humboldt Basin. The focal point of this use is the Ruby Mountains. Forest Service statistics for the Ruby Division of the Humboldt National Forest estimate a total 123,750 visitor days in the Rubies for 1962. If the rate of recreation use continues to climb each year as it has since 1960, it could reach well over 400,000 visitor days annually by the year 2,000. To meet this expected influx, both the Forest Service and Bureau of Land Management have plans for additional recreation site development, improved access roads and trails, etc. The proposed Corps of Engineers Hylton dam and reservoir would also greatly enhance the sub-basin's recreation potential.

Regular Department of Agriculture and other Federal and State programs can provide assistance in accomplishing many needed improvements in the sub-basin. The regular programs of the Forest Service and the Bureau of Land Management provide for improvement on the Federal lands those agencies administer to the extent that currently available funds permit.

Opportunities for project developments were evaluated for four watersheds in the sub-basin - Smith Creek, Dixie Creek, Lamoille, and Starr Valley. Improvement measures can be designed in these areas which will provide for watershed protection, increase range forage production, supply supplemental irrigation water, and reduce erosion and sediment damage on the irrigated lands. A preliminary evaluation of the works of improvement proposed for the four watershed areas indicated benefits in excess of costs sufficient to warrant a more detailed study.

HUMBOLDT RIVER BASIN SURVEY

RUBY MOUNTAINS SUB-BASIN REPORT

AUTHORITY AND ORGANIZATION

The need for continually improving the conservation and use of water and related land resources has long been recognized by Federal, State, and local agencies. A recent pertinent development of this continuing interest is River Basin studies under Section 6 of Public Law 566, as amended and supplemented.

The Secretary of Agriculture is authorized under the provisions of Section 6 of the Watershed Protection and Flood Prevention Act to cooperate with other Federal and with State and local agencies in making investigations and surveys of the watersheds of rivers and other waterways as a basis for the development of coordinated programs. In Nevada such a survey is under way by the U.S. Department of Agriculture and the Nevada State Department of Conservation and Natural Resources.

General direction for the U.S. Department of Agriculture in the conduct of the studies and preparation of the report was provided by a USDA Field Advisory Committee composed of representatives of the Soil Conservation Service, Forest Service, and Economic Research Service. The USDA River Basin Representative served as advisor and consultant to the Committee.

General direction for the State of Nevada was provided by the Director of the State Department of Conservation and Natural Resources.

A Field Party composed of representatives of the Soil Conservation Service and Forest Service completed the field work and prepared this report.

Grateful acknowledgement is made to all individuals and other State and Federal agencies who gave their counsel and technical assistance in the preparation of this report.

HISTORICAL INFORMATION

Settlement

From the advent of the white man into the upper Humboldt Basin, the Ruby Mountains and East Humboldt Range have played a significant role in the development of both Nevada and California. Peter Skene Ogden and his Hudson's Bay Company Snake Country Brigade, the first white men along the Humboldt, skirted the mountains' north extremity in 1828-1829 enroute to and from winter quarters in Ogden's Hole, east of present day Ogden, Utah.

During the period of westward overland emigration, 1841-1869, the Rubies, with their surrounding verdant valleys, served as a haven of rest and recuperation

for the trailworn and battered wagon trains using the ill-omened Hastings Cutoff of the California Emigrant Trail. At the same time, ironically, the mountains were a formidable barrier, forcing the emigrants to swing far to the southward to cross Hastings Pass. (With the establishment of the Overland Stage Lines, the Pony Express, and the Overland Telegraph, which followed Captain Simpson's 1859 Central Route survey, Hastings Pass became known as Overland Pass.)

Because of this south-north detour around the Rubies to reach the Humboldt River and the main California trail, almost ten days' travel time was added to the schedule of the wagon trains using the Hastings Cutoff. Thus were sown the seeds of disaster which overtook the illfated Reed-Donner Party in the Sierra Nevada in December 1846.

John Fremont's 1845 Great Basin expedition, which resulted in the mapping and naming of much of western Utah and eastern and central Nevada, including the Humboldt River, crossed the Rubies in September of that year. One sub-group, under Fremont and Kit Carson, crossed Harrison Pass westbound; the other sub-group, under Joseph Walker, crossed Secret Pass and traveled down the valley of the Humboldt. At that time, Fremont named these formidable mountains and the desert river after his Prussian naturalist friend, Baron Alexander von Humboldt. However, Fremont's name for the range was discarded in September 1854. A member of Colonel E. J. Steptoe's detachment searching for a feasible military route across central Nevada found "rubies" (actually garnets) in his gold pan while prospecting one of the streams above Ruby Valley, near Overland Pass. Colonel Steptoe thereupon named the range accordingly, and the name has continued in use.

To protect the travel along the Simpson Overland Route, Camp (later Fort) Ruby was established in Ruby Valley, just east of Overland Pass, in 1862. With the slackening of traffic along this route, which crossed Huntington Valley from Overland Pass in the Rubies to Chokup Pass in the Diamond Mountains, Fort Ruby was abandoned in September 1869. Its garrison was then stationed for a short time at Fort Halleck, on lower Soldier Creek, which hadbeen set up July 26, 1867. Fort Halleck was finally abondoned October 11, 1886. Many of the soldiers from both these posts, when their enlistments were up, became early settlers and ranchers in Ruby, Lamoille, South Fork, Huntington and Starr Valleys.

The first agricultural use of the sub-basin started in the South Fork Valley in 1865; however, in Lamoille Valley, such use is reputed to have started in 1864. The early settlers in these areas made money selling barley and potatoes in Austin, which was booming at the time. Strawberries, gooseberries, and cantaloupes were also raised there at that time. Starr Valley was first settled and used agriculturally in 1867 by emigrants from Ruby Valley.

The raising of wheat, barley, and other small grains continued well into the 1870's. A flour mill was established at Elko in 1875, primarily to process the wheat grown in this sub-basin and in Ruby Valley to the east. However, the raising of small grains was gradually replaced by the growing livestock industry after this date,

although this type of agriculture did continue on a fairly large scale in the Lamoille area until comparatively recent times. In 1913 a flour mill was built at Lamoille, and operated there for several years thereafter.

Livestock raising, now the sub-basin's principal industry, got its start in 1866, when Lewis Rice Bradley, one of the first stockmen, established his longhorn ranch in Mound Valley. Mr. Bradley kept expanding his holdings, until his cattle ranged all the way from Smith and Huntington Creeks through Dixie Valley and west to Pine Valley. By 1870, when he was elected Nevada's second Governor, he and his son John were numbered among the State's largest cattle operators.

Mining, now of little commercial importance, was once one of the principal activities in the sub-basin. The Railroad Mining District west of Dixie Valley was discovered in 1869, with the camp at Bullion as its main settlement, and from that time until 1887 produced $3,200,000 in silver, lead, copper and some gold. The district has been of small importance from a mining standpoint since 1905, with the exception of a period of high production during World War I. Present activity in the district is limited to prospecting and to shipments of small lots of ore from the Standing Elk property. The town of Bullion has long since disappeared.

Another early day mining enterprise was the Elko Mining and Soap Deposit Company, which in October 1875 attempted the exploitation of the "soap" deposit on the east bank of Huntington Creek above Twin Bridges. This deposit was known as early as 1849 to the emigrants traveling to California along the Hastings Cutoff. As late as1893, the finished product won a certificate of merit at the Columbian Exposition in Chicago. However, the mineral from the mine proved too difficult to process, and the soap was never a success commercially.

During the boom period of the White Pine mines at Hamilton, Treasure City, and White Pine City, 1869-72, the South Fork, Tenmile, and Huntington Valleys of the sub-basin were traversed by two toll roads between the Central Pacific Railroad at Elko and the White Pine District. Thousands of head of horses, mules, and oxen used on the toll roads subsisted on hay and grain grown in these valleys. One road, known as the Hill Beachey road, ran south out of Elko across Toller (Lamoille) Summit and down the east side of Huntington Valley. The other road, known as the Elko-White Pine Toll road, ran southwest from Elko to Twin Bridges, and then along the west side of Huntington Valley.

Another abortive enterprise, noted here only for its curiosity value, was the South Fork Wood Rafting Company, formed in May 1869, "for the purpose of rafting logs, timber, lumber and wood on the waters of the South Fork of the Humboldt River", according to the articles of incorporation in the Secretary of State's Office in Carson City. In view of the scarcity of merchantable timber in the Rubies, there is small wonder that nothing ever came of this ambitious scheme, although according to the Elko Independent, July 17, 1869, the company was engaged in clearing and preparing the South Fork channel for log drives.

The first organized effort toward the conservation and management of the soil, vegetal, and water resources of the sub-basin began with the establishment of the Ruby Mountains Forest Reserve. It was created by proclamation of President Theodore Roosevelt on May 3, 1906, and was to be managed by the U.S. Forest Service. On July 1, 1908, this Forest Reserve was consolidated with the Independence Forest Reserve, and the new unit became the Humboldt National Forest.

The Ruby Division was withdrawn from the Humboldt National Forest on June 19, 1912. Additional lands north of Overland Pass were added at this time, and the division was renamed the Ruby National Forest.

On June 6, 1917, the Ruby and Santa Rosa National Forests were combined with the Humboldt National Forest, and the new grouping was called the Humboldt National Forest, its present designation.

The unregulated, unlicensed use of the sub-basin's public domain (national land reserve) lands was terminated with the passage of the Taylor Grazing Act in 1934. In 1935, under the auspices of this act, the Grazing Service was created in the Department of the Interior to administer the public domain lands. At this time the Elko and White Pine Grazing Districts were set up to manage the national land reserve resources within the sub-basin. About 1950 the Grazing Service and the General Land Office were combined to create the present Bureau of Land Management.

In 1939 the U.S. Bureau of Indian Affairs purchased three contiguous livestock and hay ranches, totaling 9,419 acres, on the South Fork of the Humboldt River at Lee, for 20 families of the Te-Moak Band of Western Shoshone Indians. The area was acquired for the Shoshones as a partial satisfaction of obligations incurred by the U.S. Government in the treaty with Chief Te-Moak at Ruby Valley in 1863. The lands, now totaling approximately 15,700 acres, are under the jurisdiction of the Western Shoshone Indian Reservation, with agency headquarters at Owyhee, Nevada.

To promote better management of the soil, water, and range resources on the privately owned lands, the Lamoille Soil Conservation District was created June 3, 1948. The work plan for the district was approved in June 1949. The Jiggs Soil Conservation District was created March 20, 1950. The work plan for this district was approved in June 1950. The Jiggs District is serviced by technical and administrative personnel of Elko Work Unit One of the Soil Conservation Service at Elko, while the Lamoille District is operated in cooperation with Elko Work Unit Two. The Starr Valley Soil Conservation District, organized February 26, 1946, cooperates with the Wells Work Unit of the Soil Conservation Service.

Floods

In common with the rest of the Humboldt Basin, this sub-basin has been subjected to recurrent periods of flooding and high water. The earliest flood year of

record along the Humboldt River and its tributaries, including Huntington Creek, South Fork, and Starr Valley, was 1862.

For further information on the history of the Ruby Mountains Sub-Basin's floods and high water periods, refer to the section on flood damage.

Fires

On the Humboldt National Forest, five Class "E" fires (300 acres or over) have burned 3,510 acres since 1947. One of the largest fires subsequent to the establishment of the Ruby Forest Reserve in 1906 occurred in July 1947, leaving still noticeable scars on 2,200 acres of national forest range and watershed lands between Corral Creek and Toyn Creek.

On the national land reserve and private lands protected by the Bureau of Land Management and the State of Nevada's Northeastern Nevada Fire Protection District, seven Class "E" fires have burned a total of 14,920 acres since 1947. A large proportion of this acreage (12,800 acres) was consumed by two fires in July 1947, on Mitchell Creek and Bald Mountain, adjacent to the national forest lands.

PREVIOUS STUDIES

Corps of Engineers

A reservoir dam has been planned and was authorized as part of the Humboldt River Project by the Flood Control Act of 1950 at the Hylton site on the South Fork below the mouth of Tenmile Creek. The dam would be a rolled earthfill structure 99 feet high and 1,610 feet long at its crest. The reservoir would have a capacity of 120,000 acre-feet and cover an area of 3,700 acres. The purpose of the reservoir is flood control, recreation, irrigation, and sediment storage. At this writing a re-evaluation study is being made by the Corps.

Other Studies

Other technical reports covering limited or specialized fields have been made at various times in the sub-basin. Their titles are listed in the Reference section of this report.

GENERAL SUB-BASIN CHARACTERISTICS

The Ruby Mountains Sub-Basin comprises the group of watersheds which drains the west slope of the Ruby Mountains, the west slope of the East Humboldt Range, the east slope of the Pinyon, Sulphur Springs, and Diamond Ranges, and the south slope of the Elko Hills. The area lies mostly in the southwest corner of Elko County, but includes a small acreage in the northwest corner of White Pine County.

The Elko Hills parallel for about 26 miles the south side of the Humboldt River in the vicinity of Elko. They are drained principally by Tenmile Creek, with the Rabbit Creek and Dixie Creek tributaries draining the northern and southern extremities. The crest elevations are 6,000 to 7,000 feet above sea level. Elko Mountain (also known as Up River Peak) on the north rises to 7,505 feet and Grindstone Mountain on the south is 7,384 feet. The Pinyon Range has crest elevations from 6,000 to 8,000 feet, with Ravens Nest Mountain rising to 8,710 feet above sea level. The range is drained by tributaries to Dixie Creek. The Sulphur Springs Range has crest elevations from 7,000 to 8,000 feet with the highest point being 8,736 feet at the head of Dixie Creek. Tributaries to Huntington Creek, such as Indian Creek and Robinson Creek, drain the greatest part of this range, with Dixie Creek draining the slopes north of Robinson Mountain. The Diamond Mountains crest elevations are greater than 8,000 feet, with peaks in excess of 9,000 feet. They are drained by tributaries to Huntington Creek.

The Ruby Mountains are the second highest mountains in the Humboldt River Basin, being exceeded only by the Toiyabe Range. They have a total length of about 90 miles with about 65 miles bounding the Humboldt. The crest elevations are around 10,000 feet with peaks to 11,349 feet (Ruby Dome). The principal drainages from the Rubies include Huntington, Smith, South Fork, Tenmile, Lamoille, John Day, Soldier, and Secret Creeks. The East Humboldt Range, north of Secret Pass, is the northern extension of the Ruby Mountains. This range has crest elevations of around 10,000 feet with peaks to 10,566 feet. The principal drainages include, Secret, Boulder (Starr), Ackler, and Herder Creeks.

Geology

The Ruby Mountains south of Harrison Pass are composed of Paleozoic sedimentary rocks, principally limestone, dolomite and quartzite. North of this pass, and in the adjoining East Humboldt Range, they consist of a complex of metamorphic crystalline and granitic rock which includes gneiss, gneissose granite, migmatite, partly quartzitic schist, amphibolite, and minor calc-silicate rocks and marble. These mountain ranges have been uplifted along normal faults. Thrust faulting, with displacement west to east of seven to 10 miles, probably occurred in the southern Rubies. Remnants of two thrust sheets occur in the vicinity of Secret Creek Canyon, which marks a structural break between the northern Ruby Mountains and the East Humboldt Range.

Tertiary volcanic rocks cover the Diamond Mountains and lie on the eastern slopes of the Elko Hills, the Pinyon and Sulphur Springs Ranges. The lava lies partly on Tertiary sedimentary rocks. The Sulphur Springs Range has been uplifted by faulting along the west base. Grindstone Mountain and the Elko Hills have been raised and tilted southeast along faults generally parallel to the Humboldt River.

Along the South Fork, the uplands include four surfaces sloping to the valley bottoms, and northeast of Lamoille there are five. The two highest surfaces are pediments which were graded to former stable elevations of the Humboldt River

drainage between periods of active downcutting. The lower surfaces are terraces. West of the southern Rubies, this series of surfaces has not developed. The generally smooth surfaces of the pediments are veneered with quartzite gravel, and slope toward the valley lowlands at one and one-half to four percent.

Partially consolidated Tertiary sediments, conglomerate, sandstone, tuff, mudstone and shale lie in an irregular depression bordered by the mountains. They attain a thickness of 5,800 feet and possibly more. They have been deformed along marginal faults, but are relatively undisturbed within the basin. The pediments were developed largely on these deposits. Unconsolidated Quaternary alluvium lies on Tertiary deposits beneath the valley lowlands. It varies in thickness from a few to possibly 65 feet or more.

Glacial features developed by alpine glaciation are present in the high mountain areas of the Ruby Mountains and East Humboldt Range. They include cirques, glacially carved valleys, and deposits of glacial till. Cirques are steep-walled, half-amphitheatrical recesses in a mountain caused by glacial erosion (see photograph 1). The axes of glacially carved valleys which continue downward from the cirques are typically straight or broadly curving, with a U-shaped cross section (see photograph 2). Glacial scour has steepened the walls of these valleys and formed shoulders along the upper edges of the steepened walls. The larger glaciers often scoured their valleys to a level lower than that of smaller tributary glaciers and formed hanging valleys. Deposits of glacial till occur in the glaciated valleys. Lakes often occupy depressions dammed by morainal deposits (see photograph 1).

Soils

The soils have been developed from combinations of igneous, metamorphic, and sedimentary rock, and partially consolidated sediments. In the Ruby Mountains and East Humboldt Range considerable bare rock is exposed, which is conducive to high water yields. The soils in the higher elevations are well to excessively well drained, medium to stony or gravelly medium textured, and vary in depth from shallow to deep. In the lower elevations, on the terraces, alluvial fans and flood plains, the soils are more varied in texture and drainage. They are generally moderately deep to deep, poorly to well drained, with textures from medium to moderately fine. Some of these soils have hard or clay pans at varying depths, and range in salt and alkali content from none to high.

Precipitation

The average annual precipitation varies from a little over seven inches at the Sadler ranch to about 32 inches in Lamoille Canyon (see table 13, Appendix I).

Snow survey stations in the area indicate average water content from winter precipitation varies from two inches at the Ryan ranch to 30 inches at the upper Lamoille station (see table 14, Appendix I).

Photograph 1 - Echo Lake, head of Echo Canyon, Ruby Mountains, looking southeast. Note cirque headwalls in background, and morainal deposits on right foreground of photograph. FIELD PARTY PHOTO

Photograph 2 - Looking westerly down Echo Canyon, Ruby Mountains, showing typical glaciated U-shaped valley cross-section, and morainal terrace of glacial till in foreground, in vicinity of horses and men. FIELD PARTY PHOTO

Water balance studies indicate that the precipitation in the Ruby Mountains is the greatest for elevations above 10,000 feet in the vicinity of Ruby Dome, with an annual average of about 45 inches. South from Ruby Dome the precipitation along the plus 10,000 foot elevation zone decreases, with about 40 inches in the upper South Fork drainage, 30 inches in the upper Smith Creek drainage, and 25 inches in the Rubies south of Harrison Pass. North from Ruby Dome along the plus 10,000 foot elevation zone, the precipitation decreases to about 40 inches annually.

Growing Season

Average frost-free periods for agricultural lands vary through the sub-basin. The following table shows frost-free periods for stations throughout the area:

Location	Length of growing season, days
Elko	117 1/ 28° F
Lamoille Power House	138 1/ 28° F
Wells	85 1/ 28° F
Halleck	89 1/ 32° F
Hylton (Jiggs)	100 2/ 32° F

1/ U. S. Weather Bureau.

2/ Yearbook of Agriculture, 1941 - Climate and Man.

General Cover Conditions

Sagebrush-grass constitutes the predominant plant cover over much of the sub-basin. In the Ruby Mountains, the sagebrush overstory on the lower south and west exposures gives way to admixtures of chokecherry (Prunus virginiana), snowberry (Symphoricarpos spp.), serviceberry (Amelanchier alnifolia), bitterbrush (Purshia tridentata), and small rabbitbrush (Chrysothamnus viscidiflorus). Mountain mahogany (Cercocarpus ledifolius) comes in at elevations of 7,500 to 9,000 feet on many of the canyon south and west exposures. Rockspirea (Holodiscus discolor) is often found on the dry, rocky upper slopes and ridges at this same exposure and elevation range.

On the north exposures, dense thickets of suppressed aspen (Populus tremuloides) clothe the lower slopes of the westward-trending canyons, giving way above 8,500 feet to scattered stands of limber pine (Pinus flexilis) and some white bark pine (Pinus albicaulis) on the north exposures and in the high basins. On these same sites small stands of subalpine fir (Abies lasiocarpa) occur occasionally, as in the head of the main fork of Thorpe Creek, and at least one small stand of white fir (Abies concolor) has been identified, on the east exposure of Seitz Canyon, about half way up the canyon. None of these conifer stands is extensive or contains any commercial timber. It is estimated that high-altitude conifers constitute less than one percent of the Rubies' total vegetation.

Along the lower canyon bottoms in the Rubies, stream banks are lined with willow (Salix spp.) rose (Rosa spp.), dogwood (Cornus stolonifera), thinleaf alder (Alnus tenuisfolia) and Rocky Mountain maple (Acer glabrum), with a scattering of aspen. A few small stands of mountain ash (Sorbus scopulina) are found in some of these locations, principally in Echo, Seitz, and Lamoille Canyons. North of Secret Pass, these lower canyon bottoms have a greater stand percentage of aspen.

Farther up the canyon bottoms, the browse species are largely replaced by relatively open stands of medium to large aspen, with an understory, where the cover is in fair to good condition, of mixed forbs, grasses, and some snowberry. Most of the Ruby canyon heads open out into rock-ribbed glaciated basins, many of which have small lakes. These basins are floored with wet or dry meadows or with a cover of sagebrush-grass, interspersed with scattered clumps of stunted conifers. The meadow vegetation consists mainly of sedges, willows, wild buckwheat (Eriogonum spp.), and alpine grasses. On the steep slopes and upper elevations above the drainage-head basins, the scanty vegetal types usually consist of conifers and dwarf shrubs, such as snowberry, cinquefoil (Potentilla fruticosa), and rock-spirea. These species are intermingled with sometimes extensive areas of alpine sedges and grasses. Where plant cover deterioration and soil erosion have taken place, buckwheat and pokeweed fleece flower (Polygonum phytolaccaefolium) are common invaders in this sedge-grass type.

The pinyon-juniper type in the Rubies does not occur in extensive stands north of Harrison Pass, except for a relatively heavy stand of pinyon (Pinus monophylla) in the lower and middle reaches of Soldier Canyon, and scattered stands in Talbot and Lamoille Canyons. Progressing southward from Corral and Toyn Creeks (Harrison Pass), the sagebrush-grass type is gradually replaced by pinyon-juniper, in increasingly heavy stands, on the lower and middle elevations of the Rubies (up to 7,000 feet). This type extends all the way to the south boundary of the sub-basin. With increased elevations and soil acidity, the pinyon generally becomes predominant over juniper within the vegetal site, occurring in almost pure stands from Lindsay Creek southward toward Overland Pass and the sub-basin's south rim.

In the Diamond Mountains, on the west side of the sub-basin, the sagebrush-grass type on the lower slopes gives way to stands of mountain mahogany and pinyon-juniper; mostly juniper here. The heaviest stands of juniper are found on these higher slopes and in the basins from Diamond Peak north to Railroad Pass. Extensive stands of juniper also occur in the broken hills south of White Flats, between Dixie Creek and lower Huntington Creek, and on the south and east exposures of Grindstone Mountain, north of Dixie Flat. Fairly heavy stands of this species grow on the southeast exposures of the Elko Hills, between Lamoille Summit and Up River Peak.

Very few aspen stringers are found in any of the short canyons emanating from the eastward sides of the Diamond Mountains, the Sulphur Springs Range, or the Pinyon Range. Stream banks and springs here are usually lined with chokecherry, with some very small aspen groves being found in the canyon heads, principally in the vicinity of Bullion.

On upper Huntington Creek, above its junction with Smith Creek, and along Dixie, Tenmile and lower John Day Creeks, the once verdant wet saline meadows consisting of Great Basin wildrye (Elymus cinereus), alkali bluegrass (Poa juncifolia), sedges, and perennial forbs, have largely disappeared, except on relatively small acreages of irrigated hayland. Gully incision and the resultant meadow desiccation have brought about intensive deterioration of both site and cover. Extensive areas of these former meadows have been invaded and taken over by phreatophytes, principally rubber rabbitbrush (Chrysothamnus nauseosus), with smaller amounts of greasewood (Sarcobatus vermiculatus). A thin and scattered stand of ryegrass, Sandberg bluegrass (Poa secunda), bottlebrush squirreltail (Sitanion hystrix), and an admixture of worthless or noxious annual and perennial weeds form an understory to the rabbitbrush and greasewood. (See photograph 3.)

Rather extensive cottonwood (Populus fremontii) overstory areas are found in the semi-wet meadows along South Fork, from above Lee to its junction with Huntington Creek at Twin Bridges. Rose and willow occur as components of the understory, along with Kentucky and Nevada bluegrass, wet and dry meadow sedges, etc. The same vegetal aspect and general composition is found in upper Lamoille Valley, Thorpe, and Talbot Creeks; also, to a lesser extent, on the Boulder, Ackler, and Herder drainages flowing into Starr Valley. In each of these, toward the upper reaches of the bottomland, aspen begins to take over from the cottonwood. In the lower reaches, where the streams flow through extensive acreages of irrigated lands, the cottonwood overstory is replaced by narrow willow stringers along the stream margins and irrigation ditches. (See photograph 4.)

Very little of the former bluebunch wheatgrass - Nevada bluegrass - Indian ricegrass understory remains in the sagebrush-grass type over the sub-basin, except on the national forest lands in the Rubies, and on protected or inaccessible relict areas within the national land reserve in the higher reaches of the Diamond and Sulphur Springs ranges. Through grazing overuse, primarily by domestic livestock, most of this perennial grass understory has been supplanted by cheatgrass (Bromus tectorum), with areas of such increaser species as Sandberg bluegrass, needlegrass (Stipa spp.) and bottlebrush squirreltail on the upland benches and terraces. Dixie Flat, which was described in the June 18, 1870 issue of the Elko Independent as being a "wonderful winter range, with white sage (Eurotia lanata) there in abundance", now has very little of this species. This desirable plant at present has little or no significance from a standpoint of grazing use or ecological importance, not only on Dixie Flat, but throughout the entire sub-basin.

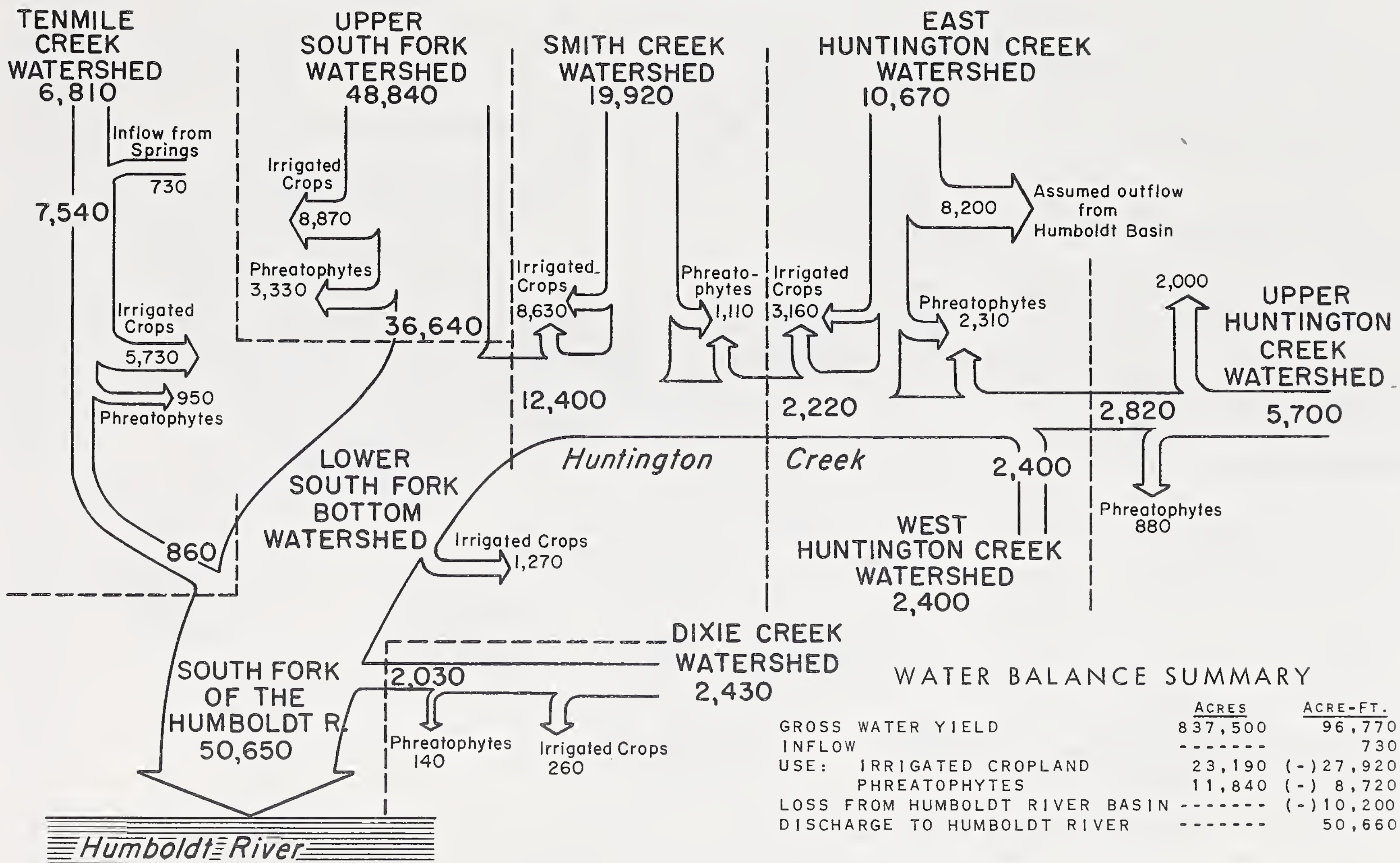
Water Yield

Irrigation water supplies are derived mostly from runoff from the Ruby Mountains north of Harrison Pass, and from the East Humboldt Range (see figures 1 and 2). Small amounts of water are obtained from wells, springs, and other drainages within the sub-basin. Water from Angel Lake, which formerly flowed into Clover Valley, has been diverted to supplement irrigation needs in the north end of Starr Valley (Willow Creek).

Photograph 3 - Phreatophyte type (rubber rabbitbrush), upper Huntington Creek Valley, looking southeast to Big and Little Bald Mountain, Ruby Mountains, immediately south of Overland Pass. FIELD PARTY PHOTO---6-692-3

Photograph 4 - Willow stringers in irrigated meadows , lower Lamoille Valley, looking northwest toward Elko (Up River) Peak. FIELD PARTY PHOTO---6-635-12

Figure 1. -- Flow Diagram of Water Yields and Depletions in acre-feet for the South Fork of the Humboldt River drainage in the Ruby Mountains Sub-Basin (80% frequency).

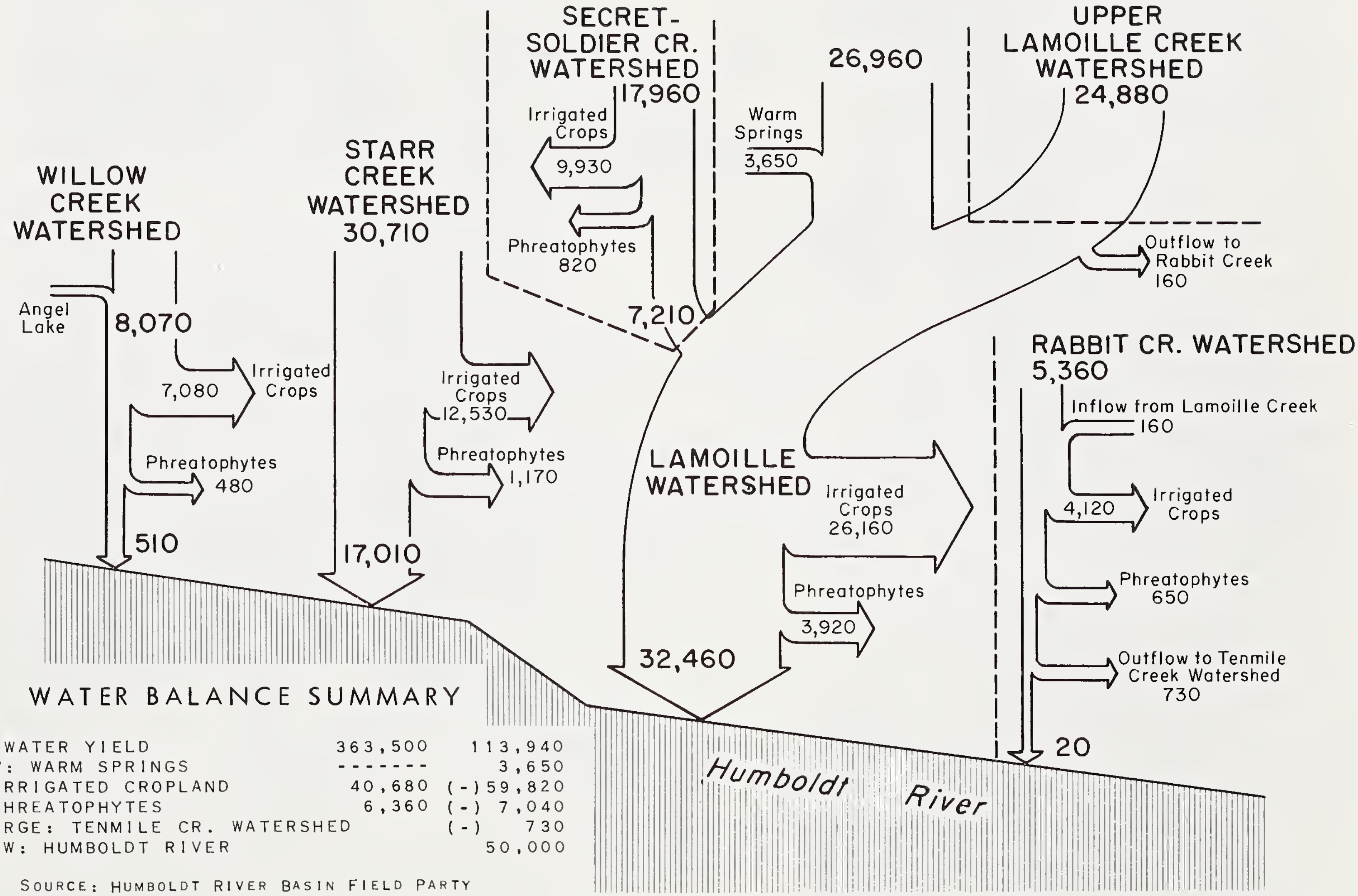


WATER BALANCE SUMMARY

		Acres	Acre-Ft.
Gross water yield		837,500	96,770
Inflow		-------	730
Use:	Irrigated cropland	23,190	(-)27,920
	Phreatophytes	11,840	(-) 8,720
Loss from Humboldt River Basin		-------	(-)10,200
Discharge to Humboldt River		-------	50,660

Source: Humboldt River Basin Field Party

Figure 2. -- Flow Diagram of Water Yields and Depletions in acre-feet for the Lamoille, Upper Lamoille Creek, Secret-Soldier Creek, Starr Valley, and Rabbit Creek Watersheds in the Ruby Mountains Sub-Basin (80% frequency)



WATER BALANCE SUMMARY

GROSS WATER YIELD	363,500	113,940
INFLOW: WARM SPRINGS	-------	3,650
USE: IRRIGATED CROPLAND	40,680	(-) 59,820
PHREATOPHYTES	6,360	(-) 7,040
DISCHARGE: TENMILE CR. WATERSHED		(-) 730
OUTFLOW: HUMBOLDT RIVER		50,000

Source: Humboldt River Basin Field Party

Considerable water is being lost from the sub-basin through the fault planes and related fractures in the limestone formation of the Ruby Mountains south of Harrison Pass. It was estimated that 80 percent of the gross yield or 10,200 acre-feet (80 percent frequency), is lost in this formation, possibly to the Ruby Lakes, Newark Valley, or Long Valley, or to a combination of these.

The canyon of Secret Creek and valleys of Lost Creek, Ackler Creek and adjacent tributaries north and south are potential areas of water loss to ground storage. Extensive thrust faulting and exposures of volcanic rock and limestone permit losses to surface flow in the vicinity of Secret Creek. In the vicinity of Ackler Creek exposures of limestone, conglomerate, quartzite and partially consolidated sediments, probably mostly glacial drift, may permit larger than normal losses to stream flow. Both of these areas warrant further study of possibilities for ground water development on adjacent lowlands.

Generally, maximum runoff from the Ruby Mountains occurs during a three-month period, May, June, and July (see figure 3). Some streams maintain a base flow throughout the year.

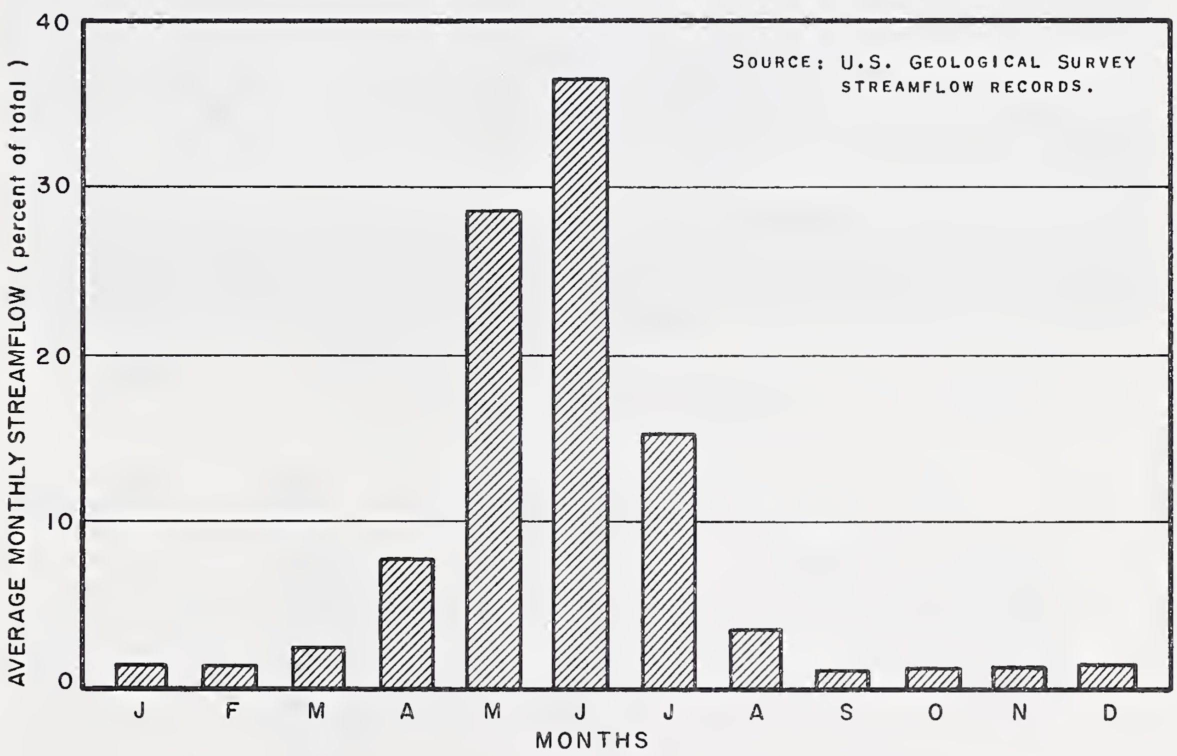


Figure 3. -- Annual streamflow distribution, Lamoille Creek near Lamoille.

It is estimated that from 60 to 70 percent of the water yield to the Humboldt River above Palisade comes from this sub-basin, with about 35 to 40 percent coming from the South Fork. The following table shows the estimated gross water yields,

irrigation and phreatophytic use, and the annual outflow to the Humboldt River, as determined from water balance studies (80% frequency):

Drainage	Gross water yield	Inflow	Use by irr. cropland & phreatophytes	Loss from Humboldt Basin	Outflow	Annual Outflow to Humboldt
South Fork	96,770	730	(-)36,640	(-)10,200	---	50,660
Rabbit Creek	5,360	160	(-) 4,770	------	(-)730	20
Lamoille to Secret Creek	73,450	---	(-)40,830	------	(-)160	32,460
Starr Creek	30,710	---	(-)13,700	------	---	17,010
Willow Creek	8,070	---	(-) 7,560	------	---	510
Total	214,360	890	(-)103,500	(-)10,200	(-)890	100,660

Detailed ground water studies have not been made, except for single well locations. There are an estimated seven wells having good quality water which have been pumped for irrigation. Capacities range from 600 to 2,000 gallons per minute.

LAND AND WATER USE

Land Status

There are approximately 165 land owners in the sub-basin, according to records of the Bureau of Land Management at Elko and Ely; the Soil Conservation Service Work Unit offices at Elko, Wells, and Ely; and the Humboldt National Forest office at Elko. Sections of Federal and private (formerly railroad) lands are intermingled in a checkerboard pattern in a line parallel with the Humboldt River along the northern half of the sub-basin.

Land Status	Square miles	Acres	% of total
National Land Reserve	803.0	513,900	42.8
Indian Reservation	24.5	15,700	1.3
National Forest	357.0	228,500	19.0
County	1.7	11,000	.1
Private	690.3	441,800	36.8
Total	1,876.5	1,201,000	100.0

Land Use

The national land reserve lands are used primarily for spring-fall and summer range for domestic livestock and as year-long range for big game and other wildlife. Land classification, fire protection, and recreation are important phases of the Bureau of Land Management program. The long range land program includes the

Photograph 5 - Water, one of the Ruby Mountains' most valuable resources. Lamoille Creek and its melting snowfields, upper Lamoille Canyon. SCS PHOTO---F-388-1

encouragement of land exchanges, in order to establish a more desirable land pattern. The Bureau's proposed recreation development program is briefly outlined in table 4.

As directed by the Multiple Use - Sustained Yield Act (Public Law 86-517) of 1960, the Forest Service administers the lands within the Humboldt National Forest to coordinate the various uses of resources - outdoor recreation, range, timber, watersheds, and wildlife and fish - without impairment of the productivity of the land. Uses on these valuable watershed lands must be carefully integrated to avoid damage.

About 95 percent of the water in this sub-basin originates on the high-elevation national forest watersheds in the Ruby and East Humboldt Ranges (see photograph 5).

The Te-Moak Indian Reservation lands are used for the production of crops and range forage. The crop lands are divided into 24 individual ranches and the range land is used in common by members of the tribe.

Private lands are used for the production of irrigated crops and range forage. Some of the private range land is in the higher mountains, and is part of the water-yielding area. In many instances exchange of use agreements and private land

permits are granted the owners of private intermingled lands, and these areas are then administered with public lands by the Bureau of Land Management and the Forest Service. The bulk of the current grazing on national land reserve range is on community allotments, although a small number of individual allotments have been established and division of the range into individual allotments is progressing.

The acreage of land irrigated and the acreage of cropland harvested vary widely from year to year depending on precipitation and stream flow. Practically all the irrigated land is used to produce winter feed for livestock. Other crops grown, primarily for ranch use, include small acreages of small grain, potatoes, vegetables, and fruit.

Water Rights

Determination of water rights was established by the Edwards Decree of 1935 and subsequent permits from the State Engineer's office. In general, the decree provides for a flow of 1.23 c.f.s. per 100 acres of decreed land or at proportional rates. The following table shows the duty of water, the acre-feet of decreed water, and the acres of decreed land in the sub-basin:

Class of Land		Dates of use	Number of days	Decreed water (acre-feet)	Decreed land (acres)
Harvest crop	(A)	4/15-8/15	120	235,260	78,575
Meadow pasture	(B)	4/15-6/15	60	4,565	3,020
Diversified pasture	(C)	4/15-5/15	30	6,925	9,060

Diverted water for irrigation purposes is measured where the main ditch enters or becomes adjacent to the land to be irrigated. As stated in the Nevada Water Laws:

> "The State Engineer shall consider the duty of water as therefore established by court decree or by experimental work in such area or as near thereto as possible. He shall also consider the growing season, type of culture, and reasonable transportation losses of water up to where the main ditch or channel enters or becomes adjacent to the land to be irrigated, and may consider any other pertinent data deemed necessary to arrive at the reasonable duty of water".

Water Use

The annual water balance studies made by the Field Party show that during an 80 percent frequency flow year the approximate gross water yield is used as follows:

	Acres	Water use acre-feet
Irrigated crops	63,850	87,700
Phreatophytes	18,200	15,800
Outflow to Humboldt River	------	100,700
Loss from Sub-Basin	------	10,200
Total		214,400

Surface Water

The dominant use of water is for irrigation. Culinary and stock water use, while of strategic importance with respect to location, quality, and availability, do not require very large quantities. To satisfy existing water rights, about 36,600 acre-feet more water are required than the watershed yields during an 80 percent frequency year.

An estimated 87,700 acre-feet of water are used to produce hay and pasture on about 63,850 acres, and 15,800 acre-feet are used by 18,200 acres of phreatophytic plants. The hay lands and phreatophyte areas are located principally along the stream bottoms, with some irrigated hay land on high flood plains and terraces. Most of the native hay and pasture land is irrigated continuously during the period of high seasonal stream flow. The remainder receives water at periodic intervals when it is available.

While use of water for irrigation and other downstream needs is highly important, the on-site requirements for water must not be overlooked. Trees, shrubs, and grass must have sizeable quantities of water to remain vigorous and keep the watershed in a healthy hydrologic condition. Downstream values are dependent on a healthy watershed to prevent damages from floods, sediment and debris. In addition, water is needed in lakes and streams for fish, aesthetic values, recreation activities, livestock, and game animals. Other on-site uses of water in the sub-basin are minor.

Ground Water

The quantity of water pumped from ground water storage for irrigation is quite small. Out of seven wells drilled, three have had but infrequent use because of low capacity. About 500 acres growing mostly alfalfa are now being irrigated from wells.

Irrigation Methods

There is a limited amount of improved irrigation development in the area. These developments consist of land leveling, land smoothing, diversion structures, spreader ditches, irrigation wells, and two irrigation water storage reservoirs. This does not include a few high lakes in the Ruby and East Humboldt Ranges. Diversion structures are the only developments that may involve more than one ranch.

Irrigation is principally by a semi-controlled type of wild flooding. Very limited use has been made of corrugation, border, and sprinkler irrigation. Water supplies from surface streams vary widely throughout the irrigation season, which makes the regulation of water difficult. During the high runoff period streamflow is either diverted or spreads out over meadow and pasture lands naturally. Ditches are used to spread the water over the land. By this method of irrigation the water is generally kept on the fields much longer than is needed to saturate the soil; this results in low irrigation efficiency, loss of fertility, and sometimes lower yields. Meadow hay and pasture forage receive part of their water needs from shallow ground water.

THE AGRICULTURAL INDUSTRY

Agriculture in the Ruby Mountains Sub-Basin is dominated by the range livestock industry. Currently, livestock enterprises consist almost entirely of production and sale of sheep and feeder-type cattle. Livestock numbers on sub-basin ranches, based on Forest Service permits and Bureau of Land Management licenses for 1962, were estimated at 23,000 cattle and 43,000 sheep.

Federal lands provide most of the spring and summer feed for the breeding herds. Of the total livestock feed required, the Federal and intermingled private rangelands furnish forage for approximately 111,000 AUM's of cattle and 190,700 AUM's of sheep. The balance of feed is provided by two or more months' private grazing on range land, crop aftermath, adjacent dry and irrigated pasture, and three to four months on hay.

Markets

The livestock shipped from the area constitute the only agricultural export of significance. They are mostly sold on the ranch to outside buyers and shipped to destination by truck at the buyer's expense. Cattle sold are chiefly calves, long yearlings, and cull cows consigned to feed yards in the neighboring States. Lambs are sold to buyers who, in turn, separate the animals, consigning them directly to packers or to feed yards. Generally, about 60 percent of the lambs go direct to packing plants. It is estimated that more than 80 percent of livestock go to California for slaughter or to the feed lots, with the remainder going to southern Idaho, Oregon, and small numbers to feed lots in other western and mid-western states.

Transportation

Transportation facilities available to the area are adequate. Two interstate rail lines, Southern Pacific and Western Pacific, serve the area and provide daily schedules from Elko and Wells to the west coast and to Ogden and Salt Lake City and points east. Both railroads offer livestock transportation service, with loading

facilities at Elko, Halleck and Wells.

Several motor freight common carriers maintain terminals in Elko, provide pick-up and delivery service at Deeth and Wells, and interstate service to all parts of the nation. Livestock transportation service is provided by local truck carriers, as well as by a number of truck carriers from Idaho and California.

Transcontinental U.S. Highway 40 (Interstate 80) at Elko, Deeth, and Wells links the area with all eastern and western points. U.S. Highway 93 at Wells links the area with all northern and southern points. Nevada Highway 43 links U.S. 40 with points in southern Idaho and Oregon. Nevada Highway 46 traverses the South Fork and Huntington Creek drainages, connecting U.S. Highway 40 with U.S. Highway 50 near Eureka. This is a graveled highway from Jiggs south. Numerous other roads and truck trails provide access to most parts of the area, at least during good weather.

Air transportation is available at Elko, with United Airlines providing a daily flight schedule - one east and one west.

WATER-RELATED PROBLEMS IN THE SUB-BASIN

Agricultural Water Management

Seasonal Distribution of Water

Generally, the major water-producing streams in this sub-basin are more sustaining than in other drainages in the Humboldt Basin. It is still necessary, however, that the water for the major acreage of cropland be applied during the high runoff period. Irrigated lands, for the most part, receive but one irrigation from surface flow. The number of acres harvested for hay varies each year, depending on the available water supply. These conditions result in the production of low-yield forage plants which will tolerate wide extremes in soil moisture over extensive periods of time.

Soils

Areas in which problems occur in soils are the valley bottomlands and the valley uplands or terraces.

The soils in the bottomlands are principally Alluvial and Humic Gley. They are usually deep, with some stratification, and are imperfectly to poorly drained. The exception to this is in the flood plains around Halleck, where the Alluvial soils are shallow over gravel. The problems are flooding, high water table, poor drainage and salt and alkali concentrations.

The valley uplands or terrace soils are principally Alluvial. They are generally either shallow to gravel or to a hardpan. The problems are excess drainage in one condition and poor drainage in the other.

Control of Water

There are two relatively small irrigation reservoirs in the sub-basin. Each of these serves but one owner. Storage development has been limited, partially because of the lack of good sites at desirable location.

With the lack of irrigation water storage, it becomes necessary to irrigate by direct diversion from streams. The water is spread over the fields by use of spreader ditches, which in most cases are spaced too far apart to obtain a uniform irrigation. Most of the ditches are not equipped with turnouts, drops, or headgate structures to give adequate control of the water. There is a limited use of corrugations to guide the water between ditches. Two enterprises irrigate by sprinkling with well water.

Irrigation Efficiency

On-the-farm irrigation efficiency is quite low; it is estimated at 25 percent. Some of the conditions that contribute to this low efficiency are continuous flooding of fields during periods of high stream flow, undulating field surfaces, lack of water control structures, and poor seasonal distribution of water.

Seepage Loss

Water loss from surface flow was observed to be high in ditches and creek channels flowing over alluvial fans. Except for the water used by phreatophytic plants and losses in the south end of the Rubies through fault planes and related fractures in the limestone, most of this seepage loss returns either down stream or to the Humboldt River.

More late season irrigation water would be available to lands in the sub-basin, except for the seepage losses.

Drainage

Salt and alkali concentrations and high water tables limit the type of crops that can be grown and the yields of these crops in some areas of the sub-basin. Some of the trouble spots are caused by over-irrigation of lands upstream. They are individual enterprise problems.

Flood Damage

As is the case with all the Humboldt sub-basins, the Ruby Mountains Sub-Basin has been subjected to many periods of flooding and of high water. There are two types of floods which have produced damage. They are: (1) the wet-mantle flood, resulting from the complete saturation of the soil mantle; and (2) the dry-mantle flood. The dry-mantle type occurs less frequently, and is usually localized at the stream sources on the higher watersheds.

Wet-Mantle Floods

The earliest flood year of record along the Humboldt River and its tributaries,

including this sub-basin, was 1862. However, as this flood period occurred prior to the first settlement and use of the sub-basin by whites, no record of flooded area or damage has been found.

The wet-mantle floods of December 1867, January 1868, January-June 1870, and May-June 1884 probably produced localized inundation and some damage in the sub-basin. However, no specific mention of flood damage in the Ruby Mountains Sub-Basin has been found prior to the wet-mantle floods of 1890.

March-June 1890. - In May 1890, high waters on the South Fork from the melting of the snow accumulations from the "White Winter" of 1889-1890 washed out the South Fork bridge on the Telegraph (Hill Beachey) road, one of the two main north-south roads between Elko and the White Pine mines. At the same time, the South Fork bridge at Twin Bridges, on the other Elko-White Pine main route, was so dangerously weakened it had to be closed for extensive repairs.

February - March 1910. - The Bullion bridge on the South Fork was washed out, isolating the mining camp of Bullion for almost two weeks. The Bullion road itself was so badly washed that much of it had to be relocated, and other bridges on the South Fork and Tenmile, Huntington, and Lamoille Creeks were left in a weakened condition. Great road damage occurred in these same localities during this flood period.

Many of the present eroded channels on Dixie Creek, lower South Fork, Tenmile and Huntington Creeks probably had their inception at this time, although no definite corroboration of this premise has been found to date. No stream gage recordings are available from the sub-basin for this year.

January - April 1914. - Wet-mantle floods along the Humboldt produced the second highest flows of record for the South Fork. The lower South Fork gage below Dixie Creek on January 26 of that year indicated 2,400 c.f.s. High waters and considerable soil washing and gullying occurred on Huntington Creek, South Fork, and Dixie Creek, many of the roads were eroded. The Bullion bridge on South Fork was again damaged; this time so heavily it had to be replaced, at a cost of $400.00. Further deepening and amplification of the gully system resulting from the 1910 floods was another unwelcome end-product of this flood period.

February - March 1917. - This wet-mantle flood, which affected only the upper Humboldt Basin above Beowawe, inflicted road and bridge damage south from Lamoille Creek. The South Fork high waters in late March caused heavy road damage between Jiggs and Elko; all bridges were washed out but one. In addition, one bridge on upper South Fork, as well as the Smith Creek bridge, were washed out. Many months and a considerable expenditure of county funds were required to repair these damages.

February - March 1921. - Flood conditions in this wet-mantle flood period

were confined generally to the upper and middle portions of the Humboldt Basin. No specific record of flood damage in the sub-basin has been found, although damage from gullying, overland flows, etc., undoubtedly did accrue there, as localized flood damage is known to have occurred both above and below Elko during this period. In general, the 1921 flood damages were not so severe as in 1914 and 1917.

January 1943. - Flood conditions in the upper Humboldt Basin from this wet-mantle flood were severe, particularly on the North Fork, at Elko, and at Carlin. No specific damages for the South Fork tributaries, Lamoille Creek or Starr Valley have been uncovered, however, although some flooding is known to have occurred in the sub-basin.

February - May 1952. - This system-wide wet-mantle flood in the Humboldt Basin, although not so severe or extensive as the floods of 1910, did much damage basin-wide. In the Ruby Mountains Sub-Basin, high water on the South Fork and its tributaries brought about flooding at Jiggs, on Smith Creek. Many bridges were washed out and roads damaged all over Elko County, including some in the sub-basin. No specific damage tabulation has been found.

February 1962. - A short but very severe wet-mantle flood period in the middle and upper Humboldt Basin above Battle Mountain inflicted widespread and heavy damages; in many areas, almost as severe as those of 1910. Within the sub-basin damage to diversion structures, irrigation ditches, headgates, and cultivated fields was extensive. A great number of creek and gully crossings on the secondary roads and jeep trails in the sub-basin were so badly washed that many of these roads remained impassible as late as the following October. Approaches to the bridges north and south of Twin Bridges on the South Fork were washed out or severely weakened. The Western Pacific Railroad grade and bridge in the vicinity of the junction of the South Fork with the Humboldt main stem were almost washed away, necessitating emergency measures.

Dry-Mantle Floods

August 1961. - A series of almost State-wide daily thunderstorms during this period caused localized dry-mantle flooding. In the sub-basin, soil damage and gullying from overland flows across the poorly vegetated benches and slopes of Dixie Creek and lower South Fork were severe in some spots.

Further details on the Humboldt flood periods are shown in the Field Party's June 1962 special report containing a chronology of Humboldt Flood years and high water years, 1861-1962.

Vegetation - Kind and Condition

Range and Watershed

Watershed conditions for most of this sub-basin are far from ideal. Past heavy grazing use by domestic livestock, and by big game in more recent times, has depleted much of the range resource, particularly in the saline bottomlands and on the upland benches and terraces. This, coupled with the decimation through overuse of the bitterbrush, mountain mahogany, and other tall browse species on the lower slopes of the Rubies, the Diamond and Sulphur Springs Ranges, and the Elko Hills, has had its effect upon the watershed cover.

The higher elevations of the Diamond and Sulphur Springs Ranges are in somewhat better condition. Extensive areas of the Rubies within the national forest, especially between Lamoille Canyon and Overland Pass, show the results of almost 60 years of protection and management of the range and watershed resource. However, in many of the high basins and on the slopes and ridges within the national forest, it is virtually impossible to find soil intact on areas grazed by sheep and cattle. Much of the destruction occurred on these thinly vegetated, thin-soiled areas 50 years or more ago, but much is still in progress. This is especially true of the checkerboard national forest-private land ownership pattern on the Central Pacific land grant north of Lamoille Canyon. Here the problem of divided Federal-private ownership has unduly complicated the management of these precariously situated, delicately balanced vegetal sites.

This pristine cover disturbance or removal through the middle and lower elevations of the sub-basin, particularly on the saline bottomlands, the upland benches and terraces (see photograph 6) and on many of the pinyon-juniper sites, has resulted in denudation or replacement by species of inferior range and watershed value. This cover disturbance or removal has contributed to topsoil loss and the development of the present deeply incised gully system along most of Huntington Creek, lower Dixie Creek, South Fork below its junction with Dixie Creek, Tenmile Creek, and lower Rabbit and John Day Creeks (see photograph 7). These gullies have lowered the water table to such an extent that many formerly extensive areas of ryegrass and other grasses and sedges have been replaced by rabbitbrush or greasewood.

Table 1 indicates the acreage by classes of present annual forage plant production, grouped by soils for each vegetal type and site. Of the 1,067,900 acres of range land, 711,100 acres (66 percent) are in the low forage production class, 212,600 acres (20 percent) in the medium class, and 144,200 acres (14 percent) in the fairly high production class. The rates in this table are indicative of the annual forage production, and must be used as a basis for planning only. The forage production figures will not be used for assigning range carrying capacities. Carrying capacity will depend upon such factors as slope, soil depth, soil character and stability, and the management objectives of the administrative agency concerned.

Photograph 6 - Sagebrush-grass type in low forage production class, upland benches and terraces site, upper Huntington Valley, looking northeast toward the Ruby Mountains. Harrison Pass in right background, and the high peaks east of Lamoille to the left. Twin Creek Ranch buildings in middle distance.

FIELD PARTY PHOTO---6-673-12

Photograph 7 - Deeply incised gully, channel of lower Mitchell Creek, one of the upper Huntington Creek tributaries. SCS PHOTO---6-181-9

Table 1. -- *Acreage of present annual range forage plant production classes, grouped by soil associations for each vegetal type and site, Ruby Mountains Sub-Basin*

Vegetal type and site	Acreage of forage plant production classes		
1. Rabbitbrush-greasewood-grass; saline bottomlands	Production classes (pounds per acre) 1/		
Soil associations	850-1,500 (acres)	200-900 (acres)	20-300 (acres)
H5-A5	1,300	1,600	20,900
H5-A5-H6	------	------	1,500
H5-B9	------	------	4,300
H5-H6	1,000	------	7,200
H5-H9-H6	500	------	2,800
H6-H5	300	------	8,700
H6-H5-A6	1,600	------	17,000
Subtotal	4,700	1,600	62,400
2. Big sagebrush-grass; upland benches and terraces	Production classes (pounds per acre) 1/		
Soil associations	250-600 (acres)	100-450 (acres)	20-150 (acres)
B4-R10-L4	------	6,500	2,000
B6-S11-A5	23,400	------	76,000
B7-B9	600	14,100	7,800
B9-B7	100	2,300	20,800
B9-S13	2,400	------	18,900
B9-S13-B7	11,500	11,100	29,600
B12-C6	------	200	14,700
C3-R10-L4	------	12,700	15,100
C6-B12	------	1,600	14,500
C7-R10	200	------	11,500
H5-C6	------	200	3,500
H5-H8-B9	800	------	4,700
R13-L5-C6	------	------	800
R15-B8-L9	------	------	10,700
S8-B4-L6	100	9,300	21,800
S10-B9	12,800	------	26,300
S11-G1	11,900	------	40,200
S12-B7	------	4,900	16,900

Continued

Table 1. -- Acreage of present annual range forage plant production classes, grouped by soil associations for each vegetal type and site, Ruby Mountains Sub-Basin -- Continued

Vegetal type and site	Acreage of forage plant production classes		
2. (Continued)	Production classes (pounds per acre) 1/		
	250-600 (acres)	100-450 (acres)	20-300 (acres)
S12-G1	3,200	------	9,800
S13-R15	100	1,400	11,200
S14-L9	2,300	------	5,000
S14-S12	------	------	4,000
S15-B6	------	7,600	27,300
S15-S13	1,900	12,500	44,600
S15-Y1	100	------	11,200
S16-S15	------	------	13,800
Subtotal 2/	71,400	84,400	462,700
3. Browse-aspen-grass; intermediate mountain slopes	Production classes (pounds per acre) 1/		
Soil associations	300-650 (acres)	150-350 (acres)	50-200 (acres)
B4-R10-L4	------	10,600	------
C7-L15-R13	------	------	7,100
L1-R11	------	18,400	8,600
L5-B4-R10	------	------	14,400
L7-R12	------	10,100	------
R13-L15-H7	10,000	5,000	21,000
R13-L5-C6	1,700	500	2,400
R13-L5-H7	2,400	6,100	15,200
Subtotal 3/	14,100	50,700	68,700
4. Browse-aspen-conifer-grass; steep mountain slopes and basins	Production classes (pounds per acre) 1/		
Soil associations	350-800 (acres)	200-500 (acres)	75-250 (acres)
L8-R14	12,200	15,900	1,800
L13-R16-Z	39,000	34,800	27,800
R13-L15-H7	1,400	1,200	5,100
Subtotal 4/	52,600	51,900	34,700

Continued

Table 1. -- Acreage of present annual range forage plant production classes, grouped by soil associations for each vegetal type and site, Ruby Mountains Sub-Basin -- Continued

Vegetal type and site	Acreage of forage plant production classes		
5. Pinyon-juniper-grass; shallow stony slopes	Production classes (pounds per acre) 1/		
Soil associations	100-250 (acres)	50-150 (acres)	10-75 (acres)
B4-R10-L4	------	3,300	8,200
B6-S11-A5	1,000	3,200	8,200
L5-B4-R10	------	------	2,800
L7-R12	------	3,300	1,000
L8-R14	------	2,600	------
R13-L5-C6	400	10,100	25,000
R15-B8-L9	------	------	29,100
S8-B4-L6	------	------	1,000
S11-G1	------	------	2,600
S12-G1	------	------	600
S15-B6	------	------	3,200
S15-S13	------	1,500	------
S16-S15	------	------	900
Subtotal 5/	1,400	24,000	82,600
Total	144,200	212,600	711,100

1/ These figures indicate total annual forage production (dry weight), and will be used as a basis for planning needs only. Forage production figures will not be used for assigning range carrying capacities. These carrying capacities will depend upon such factors as slope, soil depth, soil character and stability, and the management objectives of the administrative agency.

The rates represent production variance from poor years to good years. At higher elevations within the site, with greater precipitation the rates would be higher, and conversely for lower elevations.

2/ Does not include 1,350 acres of barren or inaccessible.
3/ Does not include 4,900 acres of barren or inacessible.
4/ Does not include 60,900 acres of barren or inacessible.
5/ Does not include 2,100 acres of barren or inaccessible.

SOURCE: HUMBOLDT RIVER BASIN FIELD PARTY.

Phreatophytes

The phreatophytes which are of low economic value (non-beneficial) consist largely of rubber rabbitbrush and greasewood, usually rabbitbrush here, in mixed or practically pure stands. Under or between these shrubs will usually be found a thin understory of Great Basin wildrye, bottlebrush squirreltail (Sitanion hystrix), and a perennial mustard, Thelypodium, along with such annuals as peppergrass (Lepidium perfoliatum) and others. On the more saline sites, the wildrye understory is generally replaced by saltgrass (Distichlis stricta). Extensive areas of cottonwood, willow, and rose are found usually as fringe areas or bottomland cover along the streams emanating from the Ruby Mountains, generally from Harrison Pass and Toyn Creek northward to the Starr Valley drainages (see photograph 8).

The saline bottomlands along upper Huntington Creek, from the Sadler Ranch southward to Connors Creek, have been invaded by rubber rabbitbrush, with a scattering of greasewood. These phreatophytes have come in as the result of the desiccation of the former wet saline meadows by the gullying of the Huntington Creek channel. From the Sadler Ranch northward to the junction of Huntington Creek with Smith Creek at the El Jiggs Ranch, the rabbitbrush generally occurs as a fringe area to the hay meadows. In many places it appears to be gradually spreading as desiccation of these meadows by the Huntington Creek gully continues. From Willow Creek to South Fork, Huntington Creek has dried out what were hay meadows prior to the 1910 flood, and rabbitbrush, with an understory of saltgrass, has taken over.

The Dixie Creek bottom, from its junction with the South Fork to approximately eight miles upstream, is in similar condition. Rabbitbrush, with some small areas of greasewood, has spread over the bottom lands desiccated by the deep gully along the Dixie Creek main channel. Similar rabbitbrush types, developed under the same conditions, exist along middle Tenmile and lower Rabbit Creek. The Soldier, John Day, and Reed Creek bottomlands have developed phreatophyte types, although the stand percentage of greasewood is higher in these areas. The rabbitbrush and greasewood types are generally found along these streams as outer fringes to the hay meadows, rather than being spread over the entire stream bottom. Thin willow fringes are found along the stream margins of lower John Day and Soldier Creeks, adjacent to the hay meadows. (See table 2.)

Timber Management

There are no merchantable commercial sawtimber stands of any size or extent within the sub-basin. On the national forest, where good Christmas tree-sized stands of pinyon pine exist, it is Forest Service policy to maintain these stands by selective thinning of the larger trees. These thinnings will provide an annual Christmas tree crop for commercial sale. Decadent pinyon stands of wolf trees, with little or no understory, will be opened or almost completely removed, leaving only small scattered clumps for livestock and wildlife shelter. Where necessary the cleared areas will be seeded to provide for deer and livestock use.

Mountain mahogany will be cut green only when necessary to open stagnated

Table 2. -- Phreatophyte acreage and annual ground water use, Ruby Mountains Sub-Basin 1/

Species	Height class	Density	Acreage cropland	Acreage range types 2/	Annual ground water use 2/ (feet)	Annual ground water use 2/ (acre-feet)
Cottonwood	15'+	.2-.4	------	1,210	4.0	4,840
Willow	8'-12'	.2-.4	------	1,410	2.2	3,110
Rose	3'-8'	.2-.4	------	630	1.5	940
Black greasewood	3'	.04-.06	------	440	.3	130
Rubber rabbitbrush	3'+	.04-.15	------	12,150	.4	4,860
Saltgrass	----	.04-.15	------	680	.5	340
Great Basin wildrye	----	.04-.15	------	1,000	1.0	1,000
Creeping wildrye	----	.05-.07	------	390	1.0	390
Alkali sacation	----	.04	------	290	.5	150
Subtotal				18,200		15,760
Irrigated meadow hay and pasture 3/	----	------	6,330		.3	1,900
Wet meadow	----	------	1,950		.5	970
Subtotal			8,280			2,870
Total			8,280	18,200		18,630

1/ The values when referred to in the text are rounded.
2/ These values are based on natural stand densities and composition, except for the irrigated and wet meadows.
3/ Mixture of Great Basin wildrye, creeping wildrye and other grasses, and sedges.

SOURCE: HUMBOLDT RIVER BASIN FIELD PARTY.

stands, or to remove decadent trees. Aspen, most valuable here as a protection type or for its esthetic value and shade in recreation areas, is removed only in stand sanitation, or to eliminate hazard trees in camp and picnic areas. Juniper sales are limited to the needs of local ranchers, because of the scarcity of good post-material juniper.

The Forest Service is continually looking for new markets, uses, and values for all species, to the extent of at least defraying the costs of the various types of cutting or removal.

On the national land reserve, except for small sales of juniper posts, there is little harvest of timber. Stands of Christmas tree-size pinyon are scarce and scattered, and trees are cut only on an individual free-use basis by residents of the Elko area.

In the sub-basin as a whole, including all classes of land ownership, there is little or no collection of pinyon nuts on a commercial basis. Pinyon stands are too scattered, and the occurrence of years of good cone and seed production too uncertain, to make it profitable commercially.

Photograph 8 - Willow fringe area in native hay meadow, middle Lamoille Valley.
SCS PHOTO --- F-83-2

Fire Protection

Fire has been of considerable significance as a causative agent of watershed damage and deterioration, particularly along the lower slopes of the Rubies and in the Sulphur Springs Range and the Diamond Mountains. With deterioration or destruction of the original plant cover, whether caused by fire or other watershed abuse, the resultant vegetation increases the fire hazard by providing flash fuels. Fires on the steep, brush-covered, thin soiled slopes of the Ruby Mountains could be seriously damaging to this important water-yielding area.

As time goes on, risks of fires caused by the rapidly increasing recreation and hunter use of the watershed lands will continue to mount. The significance of these water-yielding lands to the arid valleys below makes fire protection a factor of increasing importance. Prevention or prompt suppression of potentially disastrous range or timber fires is now and will continue to be an important facet of resource and watershed management.

RECREATION AND WILDLIFE

Recreation Developments

As the population buildup continues, and with improved roads and trails, the recreation potential of the sub-basin will become better known. More and more people will discover for themselves the beauty and scenic grandeur of the Ruby Mountains and the East Humboldt Range. With the fuller recognition and development of the largely untapped potentialities for camping, picnicking, wilderness travel, hunting, fishing, and winter sports, recreation use will become one of the sub-basin's salient assets. (See photograph 9.)

On the national forest lands alone, the Forest Service estimates that all phases of recreation use will have increased from the estimated total of 123,750 visitor days in 1962 to well over 285,000 visitor days by the year 2000. However, the latter estimate, made in 1960, was based upon extrapolation of the very conservative recreation use statistics compiled in the 1950's. If the rate of visitor days use continues to climb each year as it has since 1960, recreation use could easily climb to well over 400,000 visitor days by the year 2000. This becomes even more certain when the fact is considered that before long paved all-year access roads to Angel Lake, up Lamoille Canyon, and over Secret Pass, as well as a developed winter sports area at the head of Lamoille Canyon, are bound to play a significant role in increasing the amount of recreation use in the Rubies and the East Humboldt Range.

On both the national forest and national land reserve there are many points of great historical significance which will be visited by tourists from both within and outside the State. Some of these were important during the covered wagon period of westward migration, some during the stagecoach and Pony Express period, and some during the first flowering of the mining boom in Elko and White Pine Counties subsequent to the arrival of the Central Pacific Railroad in 1869. A few of the most

Photograph 9 - Pointing out the trout in Echo Lake, Ruby Mountains. Fishing, already one of the Rubies' best-known assets, is destined to become even more so.

FIELD PARTY PHOTO

important of these are listed here as being worthy of some type of monument or marker. They are: Overland Pass; Harrison Pass; Secret Pass; the site of the Jacob's Well Stage Station; the route of the Reed-Donner Party through lower South Fork Canyon; the Elko-Hamilton Toll Road; the Hill Beachey Toll Road; the Soap Mine; and the site of the boom town of Bullion.

Humboldt National Forest

The Angel Lake campground, with 17 family units, is the only such facility on the Wells Ranger District at present. It is located near the north extremity of the East Humboldt Range, in the Water Influence Zone of the district's multiple use plan (see page 44).

The Lamoille Ranger District presently has two campground developments: Lower Lamoille with 10 family units, and Thomas Canyon with 25 family units. Both these campgrounds are in the Lamoille Canyon Travel Influence Zone of that district's multiple use plan. There are two organization camp sites (Right Fork and Thomas Canyon) and one special use summer home site (Terraces). In planning for the multiple use of the national forest lands to meet the public's needs until the year 1975 (no projections presently available beyond that date) the

recreation survey for these two districts shows a need for the construction of an estimated additional 10 campgrounds, two organization camps, and the enlargement of one existing campsite (Angel Lake). Table 3 shows the location, time of construction, etc., of these proposed developments.

National Land Reserve

At present, there are no camp and picnic areas or any other recreation development on these lands. The Elko District of the Bureau of Land Management, in its 1959 recreation inventory report, proposes the development of several camp and picnic areas. Some unique natural features in this sub-basin will also be developed. (See Table 4.) The White Pine District has at present no contemplated recreation developments on its portion of the sub-basin's national land reserve.

Wild Life

Deer and Other Big Game Hunting

At the time of the first sustained use of the range resource of the Ruby Mountains in the late 1860's, considerable numbers of mountain sheep (Rocky Mountain bighorn) ranged the higher elevations there. Many instances of interbreeding of the bighorn rams with domestic sheep on the Ruby summer ranges were recorded in the 1869-70 issues of the Elko Independent. During the next 40 years, bighorn numbers dwindled rapidly until the species became extinct; the last wild specimens were reported in October 1921.

Mule deer ranged throughout the Rubies during this early period, but were nowhere numerous. Their numbers were undoubtedly kept down by lack of sufficient cover, predators, and uncontrolled hunting. Heavy grazing by sheep and cattle prior to the establishment of the Ruby Forest Reserve in 1906 reduced the already insufficient forage for deer, and by 1900 they had been reduced to almost a vanishing point.

Deer management was introduced with the establishment of the old County Warden system and the sale of hunting licenses about 1908. Both measures have aided herd regeneration, and deer use of the forage resource has become of increasing significance. Since 1948, when the present Nevada State Fish and Game Department was set up and scientific methods of big game management insituted, deer harvests have continued to increase.

Most of the management of big game in the Ruby Mountain Unit has been directed toward obtaining an adequate harvest of deer. This has been necessary, since over-population has resulted in overuse and damage to winter ranges. Trapping and marking studies have shown that deer from this area go to several widely separated winter ranges in the Wood Hills, Spruce Mountain, Cherry Creek and Bald Mountain areas. Track counts have shown that these various movements may

Table 3. --Planned recreation site development. Lamoille and Wells Ranger Districts, Humboldt National Forest, within Ruby Mountains Sub-Basin. 1960-1975

Site name	Ranger District	N.F.R.S. 1/ site number	Development schedule (fiscal year)	Type of development	Acres of development	F.U.'s 2/ planned	Multiple Use Management Zone
Clover	Wells	2	1964	Camp	5	15	Intermediate
Thomas Canyon	Lamoille	14	1965	Organ. Site	6	--	Travel influence
Lamoille Canyon	Lamoille	22	1970	Camp	20	60	Travel influence
Lamoille Canyon	Lamoille	20	1966	Camp	10	30	Travel influence
Toyn Creek	Lamoille	31	1967	Camp	2	6	Travel influence
Toyn Creek	Lamoille	32	1967	Camp	2	6	Travel influence
Toyn Creek	Lamoille	35	1967	Camp	3	9	Travel influence
Angel Lake	Wells	4A	1967	Camp	5	15	Water influence
Thomas Canyon	Lamoille	13	1968	Organ. Site	10	--	Travel influence
Lamoille Canyon	Lamoille	22	1971-1976	Camp	20	60	Travel influence
Lamoille Lake	Lamoille	23	1971-1976	Camp	30	90	Water influence
Liberty Lake	Lamoille	24	1971-1976	Camp	8	24	Water influence
Favre Lake	Lamoille	25	1971-1976	Camp	15	45	Water influence

1/ National Forest Recreation Survey.

2/ Family Units, calculated at 3 units per acre.

Source: U. S. Forest Service, Humboldt National Forest.

Table 4. -- Potential developments, recreation inventory report, 1959, national land reserve lands, Ruby Mountains Sub-Basin.

Site name and type of development	Acres	Site devel. cost	Access roads: Miles	Access roads: Construction cost	Access roads: Right of way acquisition cost	Yearly maint. cost	Trails: Miles	Trails: Devel. cost	Water devel. cost	Total devel. cost	Area affected acres: BLM	Area affected acres: other
West Spring picnic area (Old White Pine Toll Road, Elko Hills)	2	$1,100	1	$ 850	--------	$ 25	---	-----	$400	$ 2,350	80	———
Lamoille Summit picnic area	22	$1,100	1	$ 850	---------	$ 25	---	-----	Dry camp	$ 1,950	80	———
Lamoille extinct hot springs picnic area (Rabbit Creek Road, 5 miles north of Lamoille Highway)	1	$ 400	1	$ 850	---------	$ 25	---	-----	Dry camp	$ 1,400	160	———
Boyd's Reservoir camp site	2	$1,200	2	$1,700	$ 200	$ 50	---	-----	$300	$ 3,100	80	———
South Fork Canyon Cavern (below South Fork-Tenmile junction)	1	$5,500	5	$5,250	$ 600	$ 125	---	-----	----	$10,350	40	40
Cedar Ridge Limestone Cave (3 miles west of Smith Creek - Huntington Creek junction)	1	$5,500	4	$3,400	------	$100	---	-----	----	$ 8,900	40	———

Continued

Table 4. --Potential developments, recreation inventory report, 1959, national land reserve lands, Ruby Mountains Sub-Basin -- Continued

Site name and type of development	Acres	Site devel. cost	Access roads: Miles	Access roads: Construction cost	Access roads: Right of way acquisition cost	Access roads: Yearly maint. cost	Trails: Miles	Trails: Devel. cost	Water devel. cost	Total devel. cost	Area affected acres: BLM	Area affected acres: other
Cherry Springs camp site (Overland Pass)	1	$ 500	4	$ 1,000	------	$ 60	---	-----	$300	$ 1,800	40	-----
Bullion Organization Camp and Cabin Site (Pinyon Range)	1	$30,000	--	-------	------	-----	20	$1,000	Inc. in site dev.	$31,000	1,280	---
Robinson Basin Organization camp and cabin site(Pinyon Range)	1	$28,900	12	$10,200	$1,200	$300	30	$1,500	Inc. in site dev.	$41,800	1,280	1,280
Red Rock Summit camp site (Diamond Hills)	1	$ 500	8	$ 2,000	------	$120	---	------	$300	$ 2,800	40	-----
Indian Creek campsite (Diamond Hills)	1	$ 500	6	$ 1,500	------	$ 90	---	------	$300	$ 2,300	40	-----

SOURCE: BUREAU OF LAND MANAGEMENT, ELKO DISTRICT

consist of one to several thousand deer. Classification counts have shown this to be a very productive herd. Winter range browse studies have shown that very heavy utilization of bitterbrush and mahogany is the rule rather than the exception.

Work plans call for additional range studies, continuation of track counts, and experimental deer control fencing to facilitate gathering more accurate data on herd size and composition. The long-term objective of the deer work is to achieve the maximum hunter harvest consistent with maintaining a healthy, productive herd on range properly utilized by both big game and domestic livestock.

Two recent projects concerning the deer herd on this unit were designed to improve the winter range. One of these projects was in cooperation with the Forest Service in the Overland Pass area and the other in cooperation with the Bureau of Land Management outside the sub-basin. Both are pinyon-juniper removal projects, to release stagnated stands of deer browse.

The Nevada Fish and Game Department and the Humboldt National Forest are giving consideration to the re-establishment of the Rocky Mountain bighorn sheep or the introduction of the Rocky Mountain goat in the Rubies. Preliminary investigations are being made which may lead to the accomplishment of this project. Such planting would be made only after giving full consideration to the present and future multiple uses of the area.

Fishing

Trout fishing in the high mountain lakes and the streams of the Ruby and East Humboldt Ranges has always ranked with the best in the State of Nevada. The Nevada Fish and Game Department lists 183 fishable miles of surveyed streams, and 139.5 surface acres of lakes, in addition to many miles and acres of unsurveyed streams and lakes (see Table 18, Appendix I, and photographs 10 and 11). To insure that these fishing waters continue productive, the Department has set up a comprehensive plan of fisheries management (see Appendix I).

Small Game

The small game project plan for the Ruby Unit is divided into two segments; (1) to protect, manage, enhance, and investigate the life history requirements of native species - sage grouse, blue grouse, mourning dove, waterfowl and cottontail; (2) to protect and manage the established non-native species (chukar and Hungarian partridge and valley quail) and to investigate possibilities for the extension of their range. In addition, plans contemplate the introduction into the higher reaches of the Rubies of a new non-native species - the Himalayan snow cock. (See Appendix I.)

Photograph 10 - Trout fishing in Lamoille Canyon, Ruby Mountains. Looking south up Right Fork.
SCS PHOTO---6-553-11

Photograph 11 - Angel Lake, in the East Humboldt Range, south of Wells, Nevada. One of the best known of the fishing lakes in the Rubies - East Humboldt area.
SCS PHOTO---6-553-3

PROGRAMS OTHER THAN PROJECT-TYPE DEVELOPMENTS AVAILABLE FOR THE IMPROVEMENT OF WATER AND RELATED LAND RESOURCES

Lands in the sub-basin can be treated or can receive aid for treatment under existing U. S. Department of Agriculture and other Federal and State programs. The Forest Service and Bureau of Land Management are responsible for range, recreation, and watershed development on the Federal lands they administer. The owners of private land can receive aid for water and related land resources development by means of various programs under the U. S. Department of Agriculture.

Technical Assistance and Cost-Sharing Under Public Law 46

Under the provisions of Public Law 46 the Soil Conservation Service furnishes technical assistance through Soil Conservation Districts, and the Agricultural Conservation Program of the Agricultural Stabilization Conservation Service provides cost-sharing. Under these programs, assistance in developing coordinated conservation plans and applying conservation measures may be furnished for farms and ranches. These plans provide for soil surveys, land use adjustments, erosion control, water conservation, irrigation, drainage, flood prevention, and recreation development. Solution to the sub-basin problems on private land may be arrived at in part by these programs.

The Soil Conservation Service has the responsibility for leadership in the National Cooperative Soil Survey. With the assistance of several cooperative groups and agencies in this work, soils, maps and soil survey reports will be published in the regular schedule of soil survey publications of the U. S. Department of Agriculture.

Agricultural Water Management

There are many ways of improving water management on individual ranches throughout the sub-basin. Some of the treatments for various types of problems are listed below.

Problems	Suggested Treatment
1. Limited water supply.	a. Develop irrigation water by drainage of seeps, springs and high water table. b. Control phreatophytic plant growth. c. Construct overnight storage reservoirs, to better utilize small flows for irrigation. d. Clear stream channels of all obstructions and install controllable diversions. e. Investigate possibility of developing irrigation water wells. f. Line or seal ditches through reaches of excessive seepage loss. g. Stop applying water to fields after soil reaches saturation.

Problems	Suggested Treatment
2. Saline soils.	a. Install drains to lower water table. b. Use only good quality water for irrigation, to reduce salt concentration in the soil. c. Use proper soil and water management practices.
3. High water table.	a. Install suitable drainage. b. Improve creek channels for drainage outlets, and to reduce frequent flooding of bottomland. c. Check the possibility for pump drainage. This may increase water supply for irrigation. d. Land smoothing to remove low ponding areas. e. Line and seal ditches. f. Stop applying water to fields after soil reaches saturation.
4. Low efficiency use of water	a. Level or smooth land for uniform application. b. Reorganize water distribution and irrigation systems. c. Line ditches through highly permeable soils. d. Stop applying water when soil becomes saturated. e. Plant high-yielding crops suitable for conditions, to reduce irrigated acreage now needed for hay production.
5. Inadequate water distribution systems.	a. Remove "tight dams" and install controlled diversions. b. Reorganize water distribution systems. c. Use lined ditches or pipe lines through highly permeable soils. d. Construct necessary control structures in ditches.

Vegetal Improvement

Stream bank cutting and channel erosion as well as watershed erosion on privately owned land indicate the need for action to reverse the trend toward meadow desiccation and land deterioration. Each of the following solutions would contribute

in some measure to improvement of plant species and cover, which in turn will help reduce this erosion.

Problems		Suggested Treatment
		Irrigated lands
1. Low yields	a.	Establish higher-yielding forage crops suitable to the soil and water conditions, for hay and pasture.
	b.	Use irrigation methods that will permit more efficient use of water and create an environment for higher producing forage plants.
	c.	Develop a fertilization program.
	d.	Use feed lots when fields are wet.
		Nonirrigated Lands
1. Range condition static or on decline	a.	Practice rotation-deferred grazing,
	b.	Use bottomland pasture to supplement available range.
	c.	Control low economic value plant growth, to increase forage production.
	d.	Develop a program of range seeding.
	e.	Establish proper use practices.
2. Lack of proper management	a.	Fence to enable better grazing control and proper range use.
	b.	Improve salting and water distribution for better grazing control.

Watershed Protection and Erosion Control

The intermigled private range land in the north end of the Rubies and in the East Humboldt Range, as well as the valley upland range land stretching through Starr Valley southwest to the Pinyon Range, is generally in poor condition. The sparse cover in this area is conducive to active erosion. The treatment required to reverse the condition trend in this area would include range seeding and spraying of sagebrush on selected sites, along with good management and proper use.

Channel and gully erosion is active throughtout the sub-basin. Permanent type control structures and land treatment measures are needed to protect the existing meadows and restore desiccated meadowlands. In addition, bank sloping, seeding of banks, and channel fencing will help heal the erosion.

Possibilities for Water Salvage

Ground water use by phreatophytic plants was estimated to be about 18,600 acre-feet annually. This includes the water used by Great Basin wildrye, creeping

wildrye, and other wet meadow species used for hay and pasture in the valley bottoms. The acreage of alfalfa grown in the valley bottoms is comparatively small and therefore was not included.

Phreatophytic plants such as willows, greasewood, rabbitbrush, cottonwood, saltgrass, and wild rose, which are of low economic value, use an estimated 14,200 acre-feet of water annually. More effort should be made to control or replace these water-consuming plants by spraying, blading, and deep drainage. Cottonwood and willow, which have some value as livestock shelter, use about 7,900 acre-feet of water annually. Land owners should decide whether water or shelter has the greater value.

Forest Service Programs

National Forest Land

Following passage of the Multiple Use-Sustained Yield Act (Public Law 86-517) of June 12, 1960, the Nevada Subregion Multiple Use Management Guide was approved. In this Guide, five Management Zones - Crest, Intermediate, Valley Front, Travel Influence, Water Influence, and one Special Zone - have been delineated for coordination of uses. This is not restrictive zoning, but zoning to fully develop all resources in harmony with each other.

Management direction and management guides are set up for each zone. Within this framework, a multiple use plan has been developed for each Ranger District on the Humboldt National Forest. In the Ranger District multiple use plan, management decisions are made to coordinate uses of resources on individ- areas of national forest land within the Humboldt River Basin.

In all cases, the guiding precept of the law provides for "the management of all the various renewable surface resources of the national forests so that they are utilized in the combination that will best meet the needs of the American people" without impairment of the productivity of the land.

The Forest Service is cooperating in the National Soil Survey by surveying and mapping national forest lands. The surveys will be completed as rapidly as time and funds permit.

Watershed Treatment Measures

1. Adjust Livestock Numbers. - Adjustment of range livestock numbers to the indicated safe capacity of grazing allotments on the forest, where such satisfactory adjustment has not already been accomplished.

2. Maintain deer numbers in balance with their food supply.

3. Close the steep slopes and basins at the heads of Echo, Box, and

Rattlesnake Canyons to livestock use. Maintain the present closures at the heads of Kleckner Canyon (around Favre Lake) and Furlong Canyon (trailing privileges only).

4. Institute a system of rest-rotation grazing, in conjunction with the sheep allotment on Smith Creek.

5. Vegetal improvement by sagebrush control and range seeding of 3,500 acres of national forest land on Pearl, Brown, and Belmont Creeks.

6. Pinyon-juniper control by chaining, railing, etc., on selected areas in School Creek, Sherman Creek, Water Canyon, and the Cherry Springs area.

7. Erosion-proof approximately 40 miles of existing low-standard, primitive roads in Pearl Creek, Brown Creek, the two forks of Lindsay Creek, the south fork of Casshouse Creek, Belmont Creek, the two forks of Mitchell Creek, Schoolhouse Creek, Sherman Creek, the three forks of Sestanovich Creek, Water Canyon, Cherry Springs Canyon, and the Overland Pass area.

8. Gully-plugging in Brown Creek, the Cherry Springs area, and the Schoolhouse Field. It is estimated that structures will be needed on approximately 10 miles of stream channels.

9. Gully-plugging of eroded rills at the head of Rattlesnake and Furlong Canyons.

State and Private Lands

Under the auspices of the Clarke-McNary Act, the Forest Service cooperates with the Nevada Division of Forestry in its Northeast Elko Fire Protection District and its farm forestry program.

Other Federal Programs

National Land Reserve

The Bureau of Land Management is responsible for the administration and management of approximately 43 percent of the Ruby Mountains Sub-Basin. Highlights of the Bureau's range management program include the protection, proper use, and improvement of the national land reserve. In addition the Bureau cooperates with the Nevada Division of Forestry's Northeast Elko Fire Protection District in fire presuppression and control activities on the intermingled public and private lands.

Grazing adjudication, a phase of the range management work, includes: (l) a review and study of this base property and development of records for each grazing

user; (2) an up-to-date range forage inventory; and (3) adjustment of the stocking rate to current available forage. The program also envisions defined seasonal areas of use, range administration, and developing range improvements necessary to obtain proper distribution of livestock and more uniform and proper use of forage.

The soil and moisture program is integrated with the grazing program and consists of stabilization and rehabilitation projects necessary to conserve soil, water and closely related resources. The work also includes improvement of vegetation through natural revegetation, control of undesirable forage plants, and the seeding of more desirable plants, as well as soil surveys and hydrologic studies on pilot watershed areas. The weed control program on the national land reserve is designed to arrest the invasion of new weed species which are poisonous or mechanically injurious to domestic livestock or threaten the agricultural economy of the area. Another facet of range and watershed management which requires immediate attention is the erosion-proofing or revegetation and retirement of old, abandoned, or low-standard roads, the contributory source of a considerable amount of washing and gullying at present. It is planned that the construction of all new roads will be done to proper standards and with adequate drainage.

The national land reserve in the Ruby Mountains Sub-Basin, along with intermingled private lands, provides an important winter range for deer. Small resident herds are found in the Pinyon Range west of Bullion. The largest number of big game animals is present during the winter months, when herds migrate into the area from the Ruby and Tuscarora Mountains. The Bureau of Land Management has reserved sufficient forage for a reasonable number of big game animals, but a definite deer harvest problem exists because of limited access to the area and the lateness of the season when the deer move into it.

Indian Reservation Lands

The Bureau of Indian Affairs is responsible for administration and management of approximately 15,700 acres of the Te-Moak Indian Reservation in this sub-basin. Their improvement program includes the protection, proper use, and development of these lands.

Plans for cropland improvement (2,500 acres) consist of ditch reorganization, water control structures, and a limited amount of land smoothing, which are felt necessary for the conservation of soil and water. The improvement of range lands, which are used by the tribe members as community allotments, will be accomplished by natural revegetation and some range seeding.

Fire Protection

Two Federal agencies and one State agency are charged with the responsibility for fire prevention and suppression within the sub-basin. The Wells and the Lamoille Ranger Districts of the Humboldt National Forest are responsible for the protection of the national forest lands within their respective districts. The Elko and

the Ely Districts of the Bureau of Land Management share the fire protection job on the national land reserve. The State of Nevada, through its Clarke-McNary Northeastern Nevada Fire Protection District, protects the State and private lands, and assists the two Federal agencies in their fire suppression activities.

The following factors have helped to keep abreast of the increasing fire risks and hazards:

1. The introduction of new techniques, including more widespread and aggressive fire prevention work.

2. More and better suppression equipment. The three agencies concerned have established an airplane tanker base at Elko, to be used on suppression of wild fires.

3. The recognition of high hazard areas from the study of past fire occurence maps and fuel type maps.

4. Use of an improved national fire danger rating system.

5. Improved fire detection and radio communication.

WATERSHEDS WITH OPPORTUNITIES FOR PROJECT-TYPE DEVELOPMENT

The Watershed Protection and Flood Prevention Act (Public Law 566, 83d Congress, as amended) authorizes the Secretary of Agriculture to give technical and financial help to local organizations in planning and carrying out works of improvement in watershed or subwatershed areas of 250,000 acres or less. These projects are for: (1) flood prevention; (2) the agricultural phases of water management; (3) recreation development; and (4) other purposes, such as municipal and industrial water supplies, and improvement for fish and wildlife. Project works of improvement include land treatment measures and individual structures having not more than 5,000 acre-feet of floodwater detention capacity, or not more than 25,000 acre-feet of capacity for all purposes.

Watershed projects provide a means for coordinated scheduling of needed improvements on public and private lands which otherwise would only be accomplished over a longer period of time under regular public land programs.

A review of the entire sub-basin indicates that the problems in at least four watersheds in this sub-basin - Dixie Creek, Smith Creek, Lamoille, and Starr Valley - are such that they can best be handled on a project basis.

Dixie Creek Watershed

The Dixie Creek watershed is located in the northwest part of the sub-basin and drains into the South Fork of the Humboldt River. It contains an area of approximately

130,800 acres.

A grade stabilization structure is needed in lower Dixie Creek, to restore an estimated 1,000 acres of desiccated meadow land to a moderately high forage production class.

The range is in the low to medium forage production class. To protect the watershed and improve the range, it would be necessary to carry out such measures as fencing for better management, controlling sagebrush on selected sites, seeding suitable range sites to improved forage species, developing stockwater where needed, and controlling erosion in some areas. It is estimated that forage production can be increased by 160 percent.

A small earth fill dam can be constructed in the vicinity of the Elliott Ranch, which would form a reservoir with an estimated capacity of 20 acre-feet. This water would be used for supplemental irrigation on about 30 or 40 acres. In addition to this structural work it would be necessary to reorganize the irrigation system and install control structures on the irrigated land.

A preliminary evaluation of the works of improvement proposed for this watershed indicated benefits in excess of costs sufficient to warrant a more detailed study. (For more detailed information see Appendix I.)

Smith Creek Watershed

The Smith Creek Watershed includes about 125,300 acres of private and Federal lands bounded by Corral Creek on the south, Willow Creek on the north, the crest of the Ruby Mountains on the east, and the crest of the Juniper Hills on the west.

The main problems that were found to be significant on the irrigated land concern the seasonal distribution of water, water supply being used to produce low-yielding crops, lack of water control structures, and low efficiency of water use.

An earth dam can be constructed on Corral Creek, below the county road, that would form a reservoir with a capacity of about 700 acre-feet. The water from this reservoir would furnish supplemental irrigation to about 700 acres of cropland. There is a possibility also that this reservoir, site permitting, could be developed as a multiple-purpose structure which would include recreational features.

The range is mostly in a low to medium forage production class, with the resultant adverse effect on the livestock industry. To protect the watershed and improve the range condition it would be necessary to construct management and allotment fences, control sagebrush on selected sites, seed suitable range sites to improved forage species, develop stock water where needed, and provide erosion control in critical areas. It is estimated that the acreage of range land in a fairly

high forage production class can be increased by 460 percent. It is possible to increase forage production by 150 percent.

A preliminary evaluation of the works of improvement proposed for this watershed indicated benefits in excess of costs sufficient to warrant a more detailed study. (For more detailed information see Appendix I.)

Lamoille Watershed

The Lamoille Watershed includes about 225,400 acres of private and Federal lands bounded by Rabbit Creek on the west and Secret Creek on the northeast. The crest of the Ruby Mountains forms the east boundary and the bottomlands of the Humboldt River constitute the north boundary.

The problems on the agricultural lands that were found to be significant are: High seepage loss from ditches; poor seasonal distribution of water; high water table; water supply being used to produce low-yielding crops; and low-efficiency in water use.

In the vicinity of the town of Lamoille there are about 17,700 acres of cropland which could be benefited under a program of ditch consolidation and field ditch reorganization - 16,300 acres east of Lamoille Creek, and 1,400 acres on the west side. It is estimated that seepage loss from ditches varies from 25 to 50 percent.

The range is mostly in a low forage production class, with resultant adverse effects on the livestock industry. It is estimated that 65 percent of the range land is in a low forage production class, 17 percent in the medium class, and 18 percent in the fairly high forage production class.

Practices essential in protection of the watershed and improvement of range condition are: Management fence construction; sagebrush control on selected sites; seeding of suitable range sites to improved species; development of stockwater where needed; and erosion control in critical areas. It is estimated that the acreage of range land in a fairly high forage production class can be increased by 200 percent.

A preliminary evaluation of the works of improvement proposed for this watershed indicated benefits in excess of costs sufficient to warrant a more detailed study. (For more detailed information see Appendix I.)

Starr Valley Watershed

The Starr Valley Watershed consists of about 138,100 acres of private and Federal lands. It includes all the area northeast from the Secret Creek drainage to the sub-basin boundary west of Wells, Nevada, and between the crest of the East Humboldt Range and the bottomlands of the Humboldt River.

Problems on the agricultural lands found to be significant include: High seepage loss from ditches; poor seasonal distribution of water; high water table; water supply being used to produce low-yielding crops; and low efficiency in water use.

In the vicinity of Ackler and Herder Creeks there are about 3,100 acres of cropland which could be benefited under a program of ditch consolidation and field ditch reorganization. It is estimated that seepage loss from ditches varies from 20 to 30 percent.

The range is mostly in a low forage production class, with resultant adverse effect on the livestock industry. It is estimated that 82 percent of the range land is in a low forage production class, six percent in the medium class, and 12 percent in the fairly high production class.

Practices essential in protection of the watershed and improvement of range condition include: Consolidation of the national forest ownership pattern by a comprehensive land acquisition program for the intermingled private land; construction of management fences; control of sagebrush on selected sites; seeding of suitable range sites to improved species; and installation of erosion control measures in critical areas. It is estimated that the acreage of range land in a fairly high forage production class can be increased by 350 percent.

A preliminary evaluation of the works of improvement proposed for this watershed indicated benefits in excess of costs sufficient to warrant a more detailed study. (For more detailed information see Appendix I.)

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APPENDIX I

Pertinent elaborative material of value to the general reader, for his reference and guidance in the use of the sub-basin report.

CONTENTS

PHOTOGRAPHS

DIXIE CREEK WATERSHED

Physical Features of the Watershed

Location

The Dixie Creek watershed is located in the northwest part of the sub-basin. It is bounded on the north by the northeast extension of the Pinyon Range, on the west and the south by the Pinyon Range and on the east and south by the White Flats and Juniper Hills.

Water Supply and Use

Surface Water

Runoff from snowmelt from the Pinyon Range furnishes most of the water used for irrigation. Springs and seeps furnish the water for livestock and wildlife.

The Annual Water Balance study indicates that for an 80 percent frequency flow year the gross water yield would be about 2,400 acre-feet. Of this yield about 300 acre-feet are used by an estimated 250 acres of irrigated native hay and pasture; 100 acre-feet by phreatophytes; and 2,000 acre-feet discharge into the South Fork.

Ground Water

There have been no known ground water investigations made in the watershed nor have there been any irrigation wells drilled. There is one stockwater well on the east edge of the drainage.

The ground water table is estimated to be between 15 and 20 feet below the surface along the bottomland in the north end of the basin and around 10 feet in the south end of the valley. Sufficient information is not available to estimate the volume of water stored in the Tertiary sediment deposits.

Water Needs for Recreation Areas and Special Use Sites

Only one recreation development, a camp and cabin site covering one acre, is planned near the old townsite of Bullion. Assuming a water need of 100 gallons per acre per day, the total annual volume required for an estimated 150 days of use would be 15,000 gallons or about .05 acre-feet.

Soils and Geology

Elevations range from about 5,200 feet in the bottomlands of Dixie Creek to 8,736 in the north end of the Sulphur Springs Range, 8,400 in the Pinyon Range, and 7,384 on Grindstone Mountain.

Tertiary volcanic rocks cover the eastern slopes of the Pinyon and Sulphur Springs Ranges. The lava lies partly on Tertiary sedimentary rocks.

The Sulphur Springs Range has been uplifted by faulting along the west base. Grindstone Mountain has been raised and tilted southeast along faults generally parallel to the Humboldt River.

The soils are mostly moderately deep to deep, medium or stony and gravelly medium textured, and well drained. The exceptions are some of the mountain soils, which are shallow in depth and excessively drained, and the bottomland soils, which are deep, medium to moderately fine textured, imperfect to poorly drained, with some salt and alkali concentrations.

Vegetation

Vegetal cover on the lands above 5,200 feet consists primarily of big sagebrush-grass or juniper-grass. The browse-aspen-grass type appears as scattered stringers along the drainages and in snow pockets on the hillsides. The grass understory for all these types, where any is present, generally consists of bluebunch wheatgrass, Nevada bluegrass, some Great Basin wildrye, and an admixture of perennial and annual forbs. Much of this understory has been replaced by cheatgrass and worthless annual weeds. Small amounts of Indian ricegrass occur as a scattered understory to the extensive stands of juniper in the broken hills between Dixie Creek and lower Huntington Creek. The once extensive areas of winterfat noted in early descriptions of Dixie Flat have largely disappeared. Very little of this nutritious plant is now present, having been largely replaced by big sagebrush or other less desirable species. Seventy percent of the range forage production is in the low forage production class, and the remainder is in the medium production class.

Below 5,200 feet along the Dixie Creek channel, the cover is predominantly rabbitbrush-greasewood, of medium height and density. These phreatophytes, as a result of the gully incision and the desiccation of the wet saline meadows along the Dixie Creek bottom, have largely replaced the former stands of Great Basin wildrye, alkali bluegrass and the wet meadow sedges and forbs which once grew here. Range forage production for this site is generally low.

Land Status and Use

The land status and use is as shown below:

		Land Use					
		Range land		Irrigated land		Barren or inaccessible	
Land status	Acres	Acres	%	Acres	%	Acres	%
National Land Reserve	75,900	74,550	58	---	---	1,350	100
Private Land	54,900	54,650	42	250	100	-----	---
Total	130,800	129,200	100	250	100	1,350	100

Climate

The average annual precipitation for the watershed is estimated to vary between a low of eight inches in the low elevations to 18 inches in the higher elevations.

Assuming the growing season for irrigated crops would be similar to Elko, the annual temperatures would average about 46 degrees (F) and the length of growing season would be about 100 days (28 degrees F).

Watershed Problems

Agricultural Water Management

Irrigation water generally is depleted by the end of May. Ground water run-off after May in the north end of Dixie Creek is usually adequate for stockwater, but this flow occurs below the irrigated land. There are no storage or regulatory reservoirs in the area.

Fields are irrigated by flooding with water which is diverted directly from the creek channel. In some instances gradient spreader ditches are used to help keep the water spread over the fields.

Agricultural water management problems that were found to be prevalent are:

1. Poor seasonal water distribution.

2. Irrigation water is used to produce low-yielding crops.

3. Lack of adequate water control structures.

4. Low water use efficiency.

5. Sediment and erosion damage need to be reduced.

6. Nonbeneficial phreatophytic growth.

Flood Water, Erosion and Sediment Damage

The wet-mantle floods of December 1867 - January 1868, January-June 1870, May-June 1884, and March-June 1890 probably produced localized inundation and some damage in the sub-basin. However, Field Party investigations have revealed that the origin of much of the present eroded channel conditions on Dixie Creek and its tributaries can be traced to the January-March 1910 wet-mantle flood, as in Pine Valley, where watershed conditions and precipitation rates were similar. The Bullion bridge across South Fork immediately below its junction with Dixie Creek was washed out at that time, and the Bullion road along Dixie Creek was so badly eroded that much of it had to be relocated.

The Dixie Creek channel damage was further aggravated by the wet-mantle flood of January-April 1914, which again washed out the Bullion bridge and did much damage to the Bullion Road. The cost of replacing the bridge was $400.00. The winter wet-mantle floods of 1917, 1943, 1952, and 1962 further widened and deepened the gully system in the Dixie Creek watershed area. Also, the August 6-28, 1961 storm period, while not generally troublesome over most of the sub-basin, did produce dry-mantle flood damage along Dixie Creek, in the form of channel head-cutting and sheet and rill erosion from overland flows. It is estimated that at present about seven miles of main Dixie Creek channel are in the Forest Service Region Four channel condition Class 3 (poor) (see Appendix 1). In addition, all of the Dixie Creek tributaries from the pinyon hills to the south and east, as well as the principal ones from the west, are in the same condition class. (See photograph 12.)

There is a limited amount of sediment damage to the small irrigated acreage along Dixie Creek. However, the eroded material from Dixie Creek and its tributaries has added a considerable amount to the deposition along lower South Fork and the main Humboldt below its junction with South Fork.

Photograph 12 -- Channel erosion on lower Dixie Creek; channel condition Class 3. Near site of proposed stabilization structure. FIELD PARTY PHOTO

Vegetation - Kind and Condition

Phreatophytes

The phreatophytes which are of low economic value in the Dixie Creek Watershed consist primarily of rubber rabbitbrush and greasewood, usually rabbitbrush, in mixed or practically pure stands. Under or between these shrubs will usually be found a thin understory of Great Basin wildrye, bottlebrush squirreltail, and a perennial mustard (Thelypodium), along with such annuals as peppergrass and others. On the more saline sites, the wildrye and squirreltail understory is generally replaced by saltgrass and others.

The phreatophyte area is found primarily as a narrow stringer type along the Dixie Creek bottom, from its junction with South Fork to approximately eight miles upstream. The type has developed on the former wet saline meadows along the stream bottom, desiccated by the deep gully along the Dixie Creek channel.

Range Forage Production

Table 5 shows the acreage breakdown by range forage production class, present and potential, by vegetal type, site, and soil association. In general, the range forage production is low, with some acreage of medium forage production in the intermediate mountain and big sage-grass range sites on the west side of the watershed (Pinyon Range).

Opportunities for Development

Agricultural Water Management

There is a relatively small amount of irrigated cropland (250 acres) in this watershed. The following measures can be installed which would conserve soil and water and increase yields.

Structural Measures

It is proposed that an irrigation reorganization plan be developed which would include an estimated two miles of field ditches and a minimum of four control structures. There is a possible site for a small earth fill structure which would provide irrigation water storage, estimated at 20 acre-feet capacity, which would furnish a late irrigation to about 30 or 40 acres of hay land.

Land Treatment Measures

Land treatment measures needed would include the planting of high-yielding forage crops, fertilization, and proper water application.

Watershed Protection and Improvement

The following minimum treatment measures are considered necessary to promote

watershed protection and increase the carrying capacity of the range.

1. Construct a grade stabilization structure near the north (lower) end of Dixie Creek (see photograph 12).

2. Install bleeder-type gully plugs at selected locations in the south half of the watershed.

3. Install five spring developments, with the necessary pipe lines and watering stations.

4. Install bank sloping, revegetation, and other stream channel stabilization measures along the lower Dixie Creek channel bottom and in other locations in the south end of the watershed.

5. Treat all roads contemplated, in use, or abandoned, to prevent or stop erosion.

6. Construct approximately 40 miles of new fence to facilitate management.

7. Seed approximately 15,000 acres of range on suitable sites which are presently in the low forage production class.

8. Control sagebrush-browse on an estimated 15,000 acres of range land by selective spraying of suitable sites.

9. Remove rabbitbrush and some greasewood on an estimated 1,000 acres by blading along the Dixie Creek bottomland.

Flood Prevention

The treatment measures proposed under Agricultural Water Management, Watershed Protection and Improvement will, in a small way, help to control floods and sediment damage to lands down stream along Dixie Creek and the Humboldt River.

Benefits Expected

Watershed Protection and Improvement

The benefits expected from this proposed project would accrue mostly from the watershed protection and range improvement phase of the program. It is anticipated that the improvement program would reduce the number of acres required for an AUM of grazing from about 18 acres to seven acres, or an increase in forage yield approximately 160 percent (see table 5).

The grade stabilization and gully control measures would restore an estimated

Table 5 -- Acreage classes of present and potential annual forage plant production classes, grouped by soil associations for each vegetal type and site, Dixie Creek watershed.

Vegetal type and site	Present annual forage plant production classes (acres)			Potential annual forage plant production classes (acres)			Treatment needed to reach potential
1. Rabbitbrush-greasewood-grass; saline bottomlands	Production classes (pounds per acre) 1/			Production classes (pounds per acre) 1/			
Soil associations	850-1,500	200-900	20-300	850-1,500	200-900	20-300	
H5-H6	------	------	4,900	2,900	1,500	500	Brush removal by blading, seeding of selected areas, streambank and channel stabilization, fencing, proper management and stocking
Subtotal			4,900	2,900	1,500	500	
2. Big sagebrush-grass; upland benches and terraces	Production classes (pounds per acre) 1/			Production classes (pounds per acre) 1/			
Soil associations	250-600	100-450	20-150	250-600	100-450	20-150	Bush removal and seeding, selective spraying, fencing, stockwater development, erosion-proofing of roads, streambank and channel stabilization, proper management and stocking.
B4-R10-L4	------	6,500	2,000	2,000	5,500	1,000	
C3-R10-L4	------	11,300	6,400	9,000	7,700	1,000	
R15-B8-L9	------	------	8,300	1,000	4,000	3,300	
S15-B6	------	7,600	27,300	24,000	6,000	4,300	
S16-S15	------	------	13,800	1,000	2,000	10,800	
Subtotal		25,400	57,800	37,000	25,200	20,400	
3. Browse-aspen-grass; intermediate mountain slopes	Production classes (pounds per acre) 1/			Production classes (pounds per acre 1/			
Soil associations	300-650	150-350	50-200	300-650	150-350	50-200	Gully plugs, erosion-proofing of roads, fencing, stockwater development, proper management and stocking.
B4-R10-L4	-----	2,800	-----	1,800	1,000	-----	
L1-R11	-----	9,000	3,900	6,500	5,400	1,000	
Subtotal		11,800	3,900	8,300	6,400	1,000	

Continued

Table 5 -- Acreage classes of present and potential annual forage plant production classes, grouped by soil associations for each vegetal type and site, Dixie Creek watershed -- Continued

Vegetal type and site	Present annual forage plant production classes (acres)			Potential annual forage plant production classes (acres)			Treatment needed to reach potential
4. Pinyon-juniper-grass; shallow stony slopes	Production classes (pounds per acre) 1/			Production classes (pounds per acre) 1/			
Soil associations	100-250	50-150	10-75	100-250	50-150	10-75	
B4-R10-L4	-----	------	7,400	500	4,800	2,100	Fencing, stockwater development, erosion-proofing of roads, streambank and channel stabilization, proper management and stocking.
R15-B8-L9	-----	------	13,900	900	9,000	4,000	
S15-B6	-----	------	3,200	500	2,100	600	
S16-S15	-----	------	900	---	600	300	
Subtotal			25,400	1,900	16,500	7,000	
Total 2/	-----	37,200	92,000	50,100	49,600	28,900	

1/ These figures indicate total annual forage production, and will be used as a basis for planning needs only. Forage production figures will not be used for assigning range carrying capacities. These carrying capacities will depend upon such factors as slope, soil depth, soil character and stability, and the management objectives of the administrative agency.

These rates represent production variance from poor years to good years. At higher elevations within the site, with greater precipitation the rates would be higher, and conversely for lower elevations.

2/ Does not include 1,350 acres of barren or inacessible land.

SOURCE: HUMBOLDT RIVER BASIN FIELD PARTY

1,000 acres of desiccated meadow land to a higher forage production class. This in turn would reduce the amount of sediment that is being added to the Humboldt River.

Agricultural Water Management

The proposed treatment for the irrigated lands, including the small irrigation water storage for supplemental water, would increase the forage yield by an estimated 100 tons, or about 0.4 ton of hay or pasture per acre.

Conclusions

The condition of the watershed, which is at present detrimental to the livestock industry, can be improved by a program of range forage restoration and erosion control.

Treatment measures on the cropland would increase the forage yields, which in turn would help to bring the winter feed program in balance with summer grazing.

The total benefits from all structural and land treatment measures would be compared to the total costs. The preliminary evaluation indicated benefits in relation to costs to be favorable, and a more detailed study is warranted.

SMITH CREEK WATERSHED

Physical Features of the Watershed

Location

The Smith Creek watershed is located generally north and east from the vicinity of Jiggs, Nevada. It includes the drainages ot the Ruby Mountains from Corral Creek north through Willow Creek and from the crest of the Rubies west across Huntington Creek to the summit of the Juniper Hills. The area covers about 125, 300 acres of private and Federal lands.

Water Supply and Use

Surface Water

Runoff from the Ruby Mountains furnishes practically all of the water that is used for irrigation. The annual water balance study indicates that for an 80 percent frequency flow year the gross water yield would be about 19,900 acre-feet. An additional 2,200 acre-feet flows into the watershed from Huntington Creek on the south. Of this total water supply, 22,100 acre-feet, it is estimated that 8,600 acre-feet is used by irrigated crops, 1,100 acre-feet by phreatophytes, and 12,400 acre-feet is discharged into the South Fork.

At the present time there is one irrigation storage reservoir in the area. This reservoir is an off-channel site, which is filled with water from a diversion out of Smith Creek. It is a single purpose reservoir and serves one owner. The capacity of this reservoir is about 350 acre-feet.

Ground Water

There have been no known ground water investigations made in the watershed except on an individual site basis.

Ground water development in the area consists of one irrigation well (NE 1/4, S16, T 30 N, R 56 E) having a capacity of 840 g.p.m., and two stockwater wells (SW 1/4, SW 1/4, S 15, T 30 N, R 55 E - NE 1/4, S 36, T 31 N, R 55 E).

Water Needs for Recreation Areas and Special Use Sites

Three camp and picnic areas are planned along Toyn Creek with a total of approximately 21 family units. Assuming a water need of 700 gallons per day, the annual water requirement for 120 days would be 84,000 gallons or about .26 acre-feet.

Soils and Geology

Elevations range from about 5,300 feet in the bottomlands on Huntington Creek to 10,919 feet in the Rubies and 7,137 feet in the Juniper Hills.

The Ruby Mountains in this section of the sub-basin are composed of metamorphic and granitic rock. They have been uplifted along normal faults. Partially consolidated Tertiary sediments, conglomerate, sandstone, tuff, mudstone and shale lie in an irregular depression bordered by these mountains.

Soils above the elevation of 7,000 feet are mostly excessively drained, stony and gravelly moderately coarse textured, and vary in depth from shallow to moderately deep over bedrock. There are considerable areas of rock outcrop as well as some deep, gravelly medium textured soils in the canyon bottoms.

On the alluvial fans and terraces the soils are mostly moderately deep to deep, medium or stony medium textured, and well drained. There are some areas where a hard pan can be found at moderate depth.

The valley bottom soils are generally deep, medium to moderately fine textured, moderately well to imperfectly drained, and may contain salt and alkali concentrations.

Vegetation

At the lower elevations the vegetal cover has a general sagebrush aspect, with mixed browse-aspen-grass at the higher elevations on the lands within the national forest. Bluebunch wheatgrass, Idaho fescue, squirreltail, needlegrass, mountain brome, and Kentucky, Sandberg and Nevada bluegrass are found in these higher areas. They grow as an understory to the browse-aspen cover, in varying degrees of composition and density. Extensive areas of cheatgrass form an understory to the sagebrush aspect on much of the lower country.

Along Huntington Creek, between Willow Creek and the Huntington-South Fork junction, the channel has desiccated the former wet saline meadows and these areas have been invaded by rubber rabbitbrush and some greasewood. A thin understory of Great Basin wildrye and squirreltail, with relatively worthless perennial and annual forbs, grows under and between the rabbitbrush. West of Huntington Creek, a juniper stand with a scattered ricegrass and cheatgrass understory forms the principal vegetal type on the broken terrain. In its present condition, this juniper stand has little value from the standpoint of timber production, watershed protection, or range use.

Land Status and Use

The land status and use breakdown is as shown below:

Land status	Acres	Land Use: Range land Acres	%	Irrigated land Acres	%	Barren or inaccessible Acres	%
National Forest	52,900	49,800	43	-----	---	3,100	89
National Land Reserve	38,900	38,500	34	-----	---	400	11
Private	33,500	26,700	23	6,800	100	-----	--
Total	125,300	115,000	100	6,800	100	3,500	100

The private land is divided among an estimated 19 owners, including 2,600 acres belonging to the Southern Pacific Railroad. There are about 13 ranch operating units within the boundaries of the watershed.

The irrigated land is used to produce hay and pasture for winter feeding of cattle grazing on the intermingled private and Federal lands. There are about 450 acres of alfalfa, and the remainder of the irrigated cropland is in native hay and pasture.

Climate

The average annual precipitation is estimated to vary between a low of 12 inches at Jiggs to a high of about 30 inches in the Rubies. The growing season is about 100 days (28 degrees F).

Watershed Problems

Agricultural Water Management

Generally, by the end of June the irrigation water supply is depleted. There is one off-stream storage reservoir in the watershed which has a water right out of Smith Creek. This reservoir has a capacity of 350 acre-feet; the water is used to irrigate land on one ranch in the Cottonwood drainage.

Each ranch has one or more diversions and distribution systems. The general practice is to maintain a diversion in the creek channel for each field ditch. The number of acres irrigated each year depends on the water supply available. All the native hay and pasture lands are flooded, but in some fields gradient ditches are used to spread the water. Only limited use has been made of the corrugation and border methods of irrigation. One ranch is using a sprinkler system to irrigate part of its land.

Agricultural water management problems which were found to be prevalent are:

1. Poor seasonal water distribution.
2. The water supply is used to produce low-yielding crops.
3. Lack of adequate water control structures.
4. Low water use efficiency.
5. Sediment and erosion damage.

Flood Water, Erosion and Sediment Damage

The wet-mantle floods of December 1867-January 1868, January-June 1870, May-June 1884, and March-June 1890 probably produced localized inundation and some damage in the watershed. However, investigation has revealed that the origin of much of the present eroded channel conditions on Huntington Creek between Willow Creek and the South Fork can be traced to the January-March 1910 wet-

mantle flood. One small ranch was abandoned at the time, because of the destruction of its hay lands along the Huntington Creek bottom.

The channel damage along Huntington Creek was further aggravated by the wet-mantle floods of January-April 1914. The winter wet-mantle floods of 1917, 1943, 1952, and 1962 further widened and deepened the gully system along Huntington Creek and its tributaries from the west. The August 6-28, 1961 storm period, while not generally troublesome over much of the sub-basin, did produce overland flows, rills and gullying in this same Huntington Creek area.

It is estimated that approximately six miles of the Huntington Creek channel are in Forest Service Region Four channel condition Class 3 (poor). In addition, the Huntington Creek tributaries from the west are in that condition class, (see Appendix I). Many of the roads in this same area are rutted and washed. In the Rubies, the steep slopes at the heads of McCutcheon, Smith, Gennette and Gilbert Creeks, laid bare in the past by heavy grazing use, have suffered sheet erosion damage. The upper three miles of the Corral Creek channel are cut out, being in channel condition Class 3. Old roads along the drainages from Corral Creek northward to Gennette Creek are rutted and washed.

There is a limited amount of sediment damage to the irrigated acreage. The eroded material from Huntington Creek has undoubtedly added to the deposition along lower South Fork and the main Humboldt.

Vegetation - Kind and Condition

Preatophytes

From Willow Creek to South Fork, Huntington Creek has desiccated what were hay meadows prior to the 1910 flood, and rabbitbrush, with an understory of saltgrass or wildrye and squirreltail, and a mixture of worthless forbs, has taken over. For the watershed as a whole, about 1,100 acre-feet of water are used by 1,500 acres of these phreatophytes. This includes the willow stringers along several stream bottoms (see table 6).

Range Forage Production

Table 7 gives range forage production acreage, present and potential, on the Smith Creek watershed. This information is arranged by vegetal type, site, and soil association. In general, the range in the fairly high forage production class is found in the browse-aspen-conifer grass sites on the steep mountain slopes and basins of the Ruby Mountains. Most of the range in the medium forage production class is found in the same range vegetal site, with smaller acreages in the intermediate mountain slopes site. The bulk of the low forage production class is found in the big sagebrush-grass vegetal site, on the upland benches and terraces. It is estimated that 72 percent of the range is in a low forage production class, 19 percent in medium, and nine percent in the fairly high production class.

Table 6. -- Phreatophyte acreage and annual ground water use, Smith Creek watershed, Ruby Mountains Sub Basin 1/

Species	Height class	Density	Acreage cropland	Acreage range types 2/	Annual ground water use 2/ (feet)	Annual ground water use 2/ (acre-feet)
Willow	8'-12'	.2-.4	-----	140	2.2	310
Rubber rabbit brush	3'+	.05-.07	-----	920	.4	370
Saltgrass	-----	.05-.07	-----	70	.5	40
Great Basin wildrye	-----	.05-.07	-----	220	1.0	220
Creeping wildrye	-----	.05-.07	-----	170	1.0	170
Subtotal				1,520		1,110
Irrigated meadow hay and pasture 3/	-----	-------	3,300		.3	990
Wet meadow	-----	-------	300		.5	150
Subtotal			3,600			1,140
Total			3,600	1,520		2,250

1/ The values when referred to in the text are rounded.
2/ These values are based on natural stand densities and composition, except for the irrigated and wet meadows.
3/ Mixture of Great Basin wildrye, creeping wildrye and other grasses, and sedges.

Source: Humboldt River Basin Field Party

Table 7. -- *Acreage classes of present and potential annual forage plant production classes, grouped by soil associations for each vegetal type and site, Smith Creek watershed.*

Vegetal type and site	Present annual forage plant production classes (acres)			Potential annual forage plant production classes (acres)			Treatment needed to reach potential
1. Rabbitbrush-greasewood-grass; saline bottomlands	Production classes (pounds per acre) 1/			Production classes (pounds per acre) 1/			
Soil associations	850-1,500	200-900	20-300	850-1,500	200-900	20-300	
H5-A5	-----	1,200	9,500	6,500	3,000	1,200	Brush removal by blading, proper management and stocking.
Subtotal	-----	1,200	9,500	6,500	3,000	1,200	
2. Big sagebrush-grass; upland benches and terraces	Production classes (pounds per acre) 1/			Production classes (pounds per acre) 1/			
Soil associations	250-600	100-450	20-150	250-600	100-450	20-150	
B6-S11-A5	-----	-----	1,800	500	1,300	-----	Brush removal and seeding, selective spraying, fencing, stockwater development, erosion-proofing of roads, proper management and stocking.
B9-B7	-----	-----	15,200	12,000	2,000	1,200	
B12-C6	-----	200	13,400	8,000	4,600	1,000	
R15-B8-L9	100	-----	200	100	200	-----	
S12-B7	-----	-----	5,700	1,000	2,500	2,200	
S12-G1	2,000	-----	5,000	4,500	1,500	1,000	
Subtotal	2,100	200	41,300	26,100	12,100	5,400	
3. Browse-aspen-grass; intermediate mountain slopes	Production classes (pounds per acre) 1/			Production classes (pounds per acre) 1/			
Soil associations	300-650	150-350	50-200	300-650	150-350	50-200	
R13-L5-C6	-----	200	1,200	700	400	300	Brush removal and seeding, erosion-proofing of roads, proper management and stocking.
R13-L5-H7	-----	4,000	10,900	8,400	5,300	1,200	
Subtotal	-----	4,200	12,100	9,100	5,700	1,500	

Continued

Table 7. -- Acreage classes of present and potential annual forage plant production classes, grouped by soil associations for each vegetal type and site, Smith Creek watershed -- Continued

Vegetal type and site	Present annual forage plant production classes (acres)			Potential annual forage plant production classes (acres)			Treatment needed to reach potential
4. Browse-aspen-conifer-grass; steep mountain slopes and basins	Production classes (pounds per acre) 1/			Production classes (pounds per acre) 1/			
Soil associations	350-800	200-500	75-250	350-800	200-500	75-250	Fencing, gully plugs, erosion-proofing of roads, proper management and stocking.
L8-R14	-----	800	400	800	400	-----	
L13-R16-Z	8,300	15,300	7,600	14,100	15,100	2,000	
Subtotal	8,300	16,100	8,000	14,900	15,500	2,000	
5. Pinyon-juniper-grass; shallow stony slopes	Production classes (pounds per acre) 1/			Production classes (pounds per acre) 1/			Chaining or cabling of pinyon-juniper, fencing, stockwater development, erosion-proofing of roads, streambank and channel stabilization, proper management and stocking.
Soil associations	100-250	50-150	10-75	100-250	50-150	10-75	
R15-B8-L9	-----	-----	11,400	2,000	6,600	2,800	
S12-G1	-----	-----	600	-----	400	200	
Subtotal	-----	-----	12,000	2,000	7,000	3,000	
Total 2/	10,400	21,700	82,900	58,600	43,300	13,100	

1/ These figures indicate total annual forage production, and will be used as a basis for planning needs only. Forage production figures will not be used for assigning range carrying capacities. These carrying capacities will depend upon such factors as slope, soil depth, soil character and stability, and the management objectives of the administrative agency.

These rates represent production variance from poor years to good years. At higher elevations within the site, with greater precipitation the rates would be higher, and conversely for lower elevations.

2/ Does not include 3,500 acres of barren or inaccessible land.

Source: Humboldt River Basin Field Party

The small acreage of intermingled private and national forest lands along some of the drainages make proper management difficult.

Opportunities for Development

Agricultural Water Management

Structural Measures

It is proposed that an earth dam be constructed across Corral Creek, at a site to be located, below the country road crossing. A reservoir behind this dam would have an estimated capacity of 700 acre-feet.

Land Treatment Measures

The reservoir on Corral Creek will only hold about one-eighth of the water which was estimated to flow during an 80 percent year. It is suggested that this stored water be used for a late irrigation on 700 acres of cropland. For better utilization of this water, some land should be leveled or smoothed and new irrigation water distribution systems established.

For all the irrigated lands within this watershed the following measures were considered necessary as a solution to the existing problems:

1. Land level about 500 acres.
2. Land smooth about 3,000 acres.
3. Land clearing of willows on about 50 acres.
4. Establish drainage on about 300 acres.
5. Construct about six diversions, about 130 other water control structures, and 60 miles of ditches.
6. Planting of high-yielding forage crops on 3,500 acres.

Watershed Protection and Improvement

The following minimum treatment measures are considered necessary to promote watershed protection and improve the range:

1. Consolidate national forest ownership pattern in Gennette, Smith, and Dry Creeks by acquisition of the small private land acreages along the drainages.
2. Adjust cattle and sheep numbers to the indicated safe grazing capacity of the national forest lands from Gennette Creek southward to Corral Creek. The same treatment is needed on the national land reserve lands in the pinyon-juniper hills west of Huntington Creek.
3. Maintain deer numbers in balance with their food supply. This is particularly important on the lower areas used as deer winter range.
4. Improve livestock distribution and uniformity of forage utilization in the Gennette and Smith Creek drainages by the institution of a rest-rotation

grazing system. On all sheep ranges, require once-over grazing.

5. Close the steep, thinly vegetated and precariously balanced slopes at the heads of McCutcheon, Smith, Gennette and Gilbert Creeks to all livestock use.
6. Sagebrush control and revegetation on approximately 18,000 acres in the big sagebrush-grass types on the upland benches and terraces.
7. Construct five miles of division fence in upper Smith and Gennette Creeks to separate sheep and cattle use, and as an aid in the institution of a rest-rotation plan of use.
8. Install bank sloping, seeding, and gully plugs in the upper three miles of Corral Creek. Approximately six miles of channel stabilization will also be needed on lower Huntington Creek and in the Juniper Hills to the west.
9. Treat all roads contemplated, in use, or abandoned, to prevent erosion. This would involve in particular the erosion-proofing of approximately 20 miles of old or abandoned roads in all the drainages from Gennette Creek south to Toyn Creek. Approximately 10 miles of the roads west of Huntington Creek need such treatment. New road construction should be to a high standard, to insure proper gradient and the installation of necessary erosion-proofing measures. Off-road cross-country travel by motorized vehicles should be discouraged, particularly in the steeper terrain.
10. Continue the Bureau of Land Management's program of stock water development (wells, development of springs and seeps). This will promote more uniform livestock distribution and range forage utilization.
11. Complete the program of fencing of management units and allotments in connection with the Bureau of Land Management's range adjudication program.
12. Brush overstory removal by blading on approximately 5,000 acres of wet saline bottom land. By so doing, the presently thin understory of wild-rye and associated grasses will have the opportunity to again become dominant over much of the site.
13. Sagebrush control by selective spraying on 11,000 acres of sagebrush-browse range for the improvement of the grass-forb understory. Some range seeding may be necessary to accomplish this.
14. Juniper removal by chaining or cabling on approximately 2,000 acres, to improve the range by thickening the grass understory.

Benefits Expected

Agricultural Water Management

The proposed irrigation reservoir would provide supplemental water for about 700 acres of cropland. This water would be available after the end of June when the streams cease to flow, and would provide additional water with which to increase forage yields. Water in excess of reservoir capacity would be available for irrigation on all the land now used for hay and pasture during the spring runoff.

There may be possibilities for additional benefits being derived from recreational developments, if the selected dam site would warrant it. The three camp sites planned by the Forest Service on Toyn Creek would add to the enjoyment of such a development.

The benefits expected on irrigated lands would be as follows:

1. Better seasonal distribution of irrigation water for 700 acres of cropland.
2. Higher irrigation efficiency.
3. Production of higher quality hay, with higher yields.
4. Increase forage yields from native hay and pasture.

<u>Watershed Protection and Improvement</u>

The land treatment and structural measures would result in reduced erosion and improved range forage production. These benefits are reflected in terms of range forage improvement in table 7. It is estimated that the acreage of range land in a fairly high forage production class can be increased by 460 percent. It is possible to increase forage production by 150 percent. This would reduce the number of acres required for an AUM of grazing from about 13 acres to five acres.

Conclusions

A reservoir on Corral Creek would furnish a late irrigation for an estimated 700 acres of cropland. In addition this reservoir may have a potential as a recreational development. Water in excess of reservoir storage would be available for irrigation during the regular period of use.

The suggested land treatment measures on irrigated lands would increase forage yields, increase water use efficiency, and obtain a better balance between summer grazing and the winter feed program.

The recommended watershed protection and range improvement practices will reduce erosion and improve the range forage production substantially.

The total benefits from all structural and land treatment measures would be compared to the total costs. The preliminary evaluation indicated benefits in relation to costs to be favorable, and a more detailed study is warranted.

LAMOILLE WATERSHED

Physical Features of the Watershed

Location

The Lamoille watershed includes and is bounded by Rabbit Creek on the west and Secret Creek on the northeast. The crest of the Rubies forms the east boundary, and the bottomland of the Humboldt River is the north boundary.

Water Supply and Use

Surface Water

Runoff from the Ruby Mountains furnishes practically all the water used for irrigation. The annual gross water yield, 80 percent frequency, for this group of drainages is estimated to be 75,200 acre-feet. With the addition of 3,600 acre-feet from Warm Springs in the John Day drainage, the total water yield is about 78,800 acre-feet. The disposition of the water is estimated to be as follows:

	Acres	Water use acre-feet
Irrigated crops	27,900	40,200
Phreatophytes	1,300	5,400
Outflow to Tenmile Creek	------	700
Discharge to the Humboldt River	------	32,500

Ground Water

There have been no known ground water investigations made in the watershed except on an individual site basis. Ground water developments in the area consist of two irrigation wells and an unknown number of low capacity water developments for farmstead and domestic livestock use. One irrigation well has a capacity of about 2,000 g.p.m. and is used to sprinkle irrigate 90 acres of alfalfa, and the other has a capacity of about 600 g.p.m. and is used for supplemental irrigation on 200 acres.

Water Needs For Recreation Areas and Special Use Sites

At present there are two camp and picnic areas, two organization campsites, and one special use summer home area developed in Lamoille Canyon. Planned recreation developments consist of two additional organization camp sites and four camp and picnic areas. The water need for these developments, installed and planned, is estimated to be six acre-feet.

Soils and Geology

Elevations range from about 5,229 feet at Halleck to 11,157 feet in the Rubies.

The Ruby Mountains in this section of the sub-basin are composed of metamorphic and granitic rock. They have been uplifted along normal faults. Par-

tially consolidated Tertiary sediments, conglomerate, sandstone, tuff, mudstone, and shale lie in an irregular depression bordered by these mountains.

Soils above 7,000 feet in elevation are mostly excessively drained, stony and gravelly moderately coarse textured, and vary in depth from shallow to moderately deep over bedrock. There are considerable areas of rock outcrop as well as some deep, gravelly medium textured soils in the canyon bottoms.

On the alluvial fans and terraces the soils are mostly moderately deep to deep, medium or stony medium textured, and well drained. There are some areas where a hardpan can be found at moderate depth.

The valley bottom soils are generally deep, medium to moderately fine textured, moderately well to imperfectly drained, and may contain salt and alkali concentrations.

Vegetation

Within the watershed the vegetal cover has a sagebrush aspect at the lower elevations, with mixed browse-aspen-grass at the higher elevations on the lands within the national forest. Bluebunch wheatgrass, Idaho fescue, squirreltail, needlegrass, mountain brome, and Kentucky, Sandberg and Nevada bluegrass are found in these higher areas. They grow as an understory to the aspen-browse cover, in varying degrees of density and composition. Cheatgrass forms an understory to the sagebrush aspect on much of the lower country.

Along lower Rabbit and Soldier Creeks and the middle reach of Secret Creek, channel incision has dried out the former wet saline meadows. As a consequence, they have been invaded by rubber rabbitbrush and some greasewood. A thin understory of Great Basin wildrye and squirreltail, with relatively worthless perennial and annual forbs, grows under and between the rabbitbrush.

The pinyon-juniper type is not extensive. A relatively heavy stand of pinyon occurs in the middle and lower reaches of Soldier Canyon, and scattered stands in Talbot and Lamoille Canyons.

Land Status and Use

The land status and use breakdown is as shown below:

		Land Use					
Land Status	Acres	Range land		Irrigated land		Barren or inaccessible	
		Acres	%	Acres	%	Acres	%
National Forest	45,000	26,800	16	------	---	18,200	72
National Land Reserve	28,500	28,500	17	------	---	------	--
County	600	600	--	------	---	------	--
Private	151,300	116,400	67	27,900	100	7,000	28
Total	225,400	172,300	100	27,900	100	25,200	100

The private land is divided among an estimated 47 owners; there is no Southern Pacific Railroad land. An estimated 35 ranch operating units are located within the watershed boundaries.

The irrigated land is used to produce hay and pasture for the winter feeding of cattle grazing on the intermingled private and Federal lands. There are about 3,650 acres of alfalfa, and the remainder of the irrigated cropland is in native hay and pasture.

Climate

The average annual precipitation varies from about eight inches at Halleck to 12 inches at Lamoille, 15 inches in Secret Valley, and 45 inches in the Rubies. The growing season for most of the irrigated land is estimated to be 100 days (28 degrees F).

Watershed Problems

Agricultural Water Management

Generally, by the middle of July the irrigation water supply is depleted. Soldier and Secret Creeks flow until the middle of June. There is one storage reservoir on Rabbit Creek, which serves one owner, with a capacity of about 830 acre-feet.

There are several ditches which serve more than one ranch; however, the majority serves but one. In the vicinity of the town of Lamoille, and in other locations as well, the seepage loss from supply ditches is quite high. It is estimated to vary between 25 and 50 percent.

All the native hay and pasture lands are flood irrigated. Only limited use has been made of corrugation and sprinkler methods of irrigating.

Agricultural water management problems which were found to be prevalent include:

1. Poor seasonal water distribution.
2. High seepage loss from ditches.
3. High water table.
4. Water supply is used to produce low-yielding crops.
5. Lack of adequate water control structures.
6. Low water use efficiency.

Flood Water, Erosion and Sediment Damage

The various flood periods discussed in the Flood Damage section of the sub-basin report probably produced localized inundation and some damage on the

watershed. However, no specific mention of any damage has been found prior to the 1910 wet-mantle flood. The winter wet-mantle floods of 1910, 1914, 1917, and 1952 produced some flooding around Lamoille, with channel head-cutting and debris deposition along lower Rabbit, Soldier and Secret Creeks. Rain and rapid snow-melt occurring over a period of years on the overgrazed and denuded slopes and basins at the heads of Dry, Lemon's, and Wright Creeks have produced sheet and gully erosion. As a result, these tributaries of Secret Creek have developed severely deteriorated watershed conditions.

Except for dry-mantle cloudbursts during June 1917 and August 1958, no specific mention of flood damages from this type flood has been found, although they probably have occurred from time to time. In June 1917, Lamoille Creek flooded, washing out the stream gage at the Lamoille Power Plant and causing some flooding and debris deposition around Lamoille and downstream from there. In August 1958 heavy runoff from a localized cloudburst falling on the extensive areas of cliff and bare rock in upper Lamoille and Talbot Canyons produced localized gullying and debris deposition in the immediate vicinity.

It was observed that at least 10 miles of the lower extremities of Secret, John Day, and the tributaries to lower Rabbit Creek are in the channel condition Class 3 (poor). Approximately two miles of the upper Soldier Creek channel and five miles of the Secret Creek headwaters (Dry, Lemon's, and Wright Creeks) are also in that class.

Vegetation - Kind and Condition

Phreatophytes

The phreatophytes of low economic value in the Lamoille watershed consist of rabbitbrush and some greasewood (principally rabbitbrush) in narrow stringer types along lower Rabbit and Soldier Creeks, in mixed or practically pure stands. Under or between these shrubs will usually be found a thin understory of Great Basin wildrye, bottlebrush squirreltail, and annual and perennial mustards. On the more saline sites, the wildrye and squirreltail are generally replaced by saltgrass.

Cottonwood overstory areas are found in the semi-wet meadows in upper Lamoille Valley, and along Thorpe and Talbot Creeks. Rose and willow occur as components of the understory, along with Kentucky and Nevada bluegrass, wet and dry meadow sedges, etc. Toward the upper reaches of the bottomland, aspen begins to take over from the cottonwood. In the lower reaches, where the streams flow through extensive acreages of irrigated meadows, the cottonwood overstory is replaced by narrow willow stringers along the stream margins and irrigation ditches.

Phreatophyte acreage and annual ground water use are shown in table 8.

Range Forage Production

Table 9 gives range forage production acreage, present and potential, on the

Table 8. -- Phreatophyte acreage and annual ground water use for Lamoille watershed, Ruby Mountains Sub-Basin 1/

Species	Height class	Density	Acreage		Annual ground water use 2/	
			Cropland	Range type	(feet)	(acre-feet)
Cottonwood	15'+	.3-.4	----	540	4.0	2160
Willow	8'-12'	.3-.4	----	560	2.2	1240
Rose	3'-8'	.3-.4	----	340	1.5	510
Black greasewood	3'(-)	.04-.06	----	400	.3	120
Rubber rabbitbrush	3'+	.04-.15	----	2660	.4	1060
Saltgrass	-----	.04-.15	----	230	.5	110
Great Basin Wildrye	-----	.04-.15	----	190	1.0	190
Sub-total				4920		5390
Irrigated meadow hay and pasture 3/	-----	-------	930	----	.3	280
Wet meadow	-----	-------	330	----	.5	160
Sub total			1260			440
Total			1260	4920		5830

1/ These values when referred to in the text are rounded.
2/ These values are based on natural stand densities and composition, except for the irrigated and wet meadows.
3/ Mixture of Great Basin wildrye, creeping wildrye, and other grasses and sedges.

SOURCE: HUMBOLDT RIVER BASIN FIELD PARTY

Table 9. -- Acreage classes of present and potential annual forage plant production classes, grouped by soil associations for each vegetal type and site, Lamoille watershed.

Vegetal type and site	Present annual forage plant production classes (acres)			Potential annual forage plant production classes (acres)			Treatment needed to reach potential
1. Rabbitbrush-greasewood-grass; saline bottomlands	Production classes (pounds per acre) 1/			Production classes (pounds per acre) 1/			
Soil associations	850-1,500	200-900	20-300	850-1,500	200-900	20-300	Brush removal by blading, brush removal and seeding, streambank and channel stabilization, proper management and stocking.
H5-B9	-----	-----	4,300	2,000	2,000	300	
H5-H6	1,000	-----	2,200	2,100	600	500	
H6-H5	300	-----	7,100	4,900	2,000	500	
Subtotal	1,300	-----	13,600	9,000	4,600	1,300	
2. Big sagebrush-grass; upland benches and terraces	Production classes (pounds per acre) 1/			Production classes (pounds per acre) 1/			
Soil associations	250-600	100-450	20-150	250-600	100-450	20-150	
B7-B9	-----	8,800	3,100	5,000	5,900	1,000	Brush removal and seeding, selective spraying, fencing, stockwater development, erosion-proofing of roads, proper management and stocking.
B9-S13	2,400	-----	18,900	12,000	8,300	1,000	
B9-S13-B7	-----	100	2,700	400	1,400	1,000	
C6-B12	-----	1,500	8,000	6,500	2,000	1,000	
C7-R10	200	-----	6,800	4,000	2,300	700	
H5-C6	-----	200	3,500	-----	2,200	1,500	
S10-B9	300	-----	1,900	1,000	700	500	
S14-L9	-----	-----	1,800	200	900	700	
S15-S13	1,900	4,300	33,400	15,500	18,100	6,000	
S15-Y1	-----	-----	1,200	-----	600	600	
Subtotal	4,800	14,900	81,300	44,600	42,400	14,000	

Continued

Table 9. -- Acreage classes of present and potential annual forage plant production classes, grouped by soil associations for each vegetal type and site, Lamoille watershed -- Continued

Vegetal type and site	Present annual forage plant production classes (acres)			Potential annual forage plant production classes (acres)			Treatment needed to reach potential
3. Browse-aspen-grass; intermediate mountain slopes	Production classes (pounds per acre) 1/			Production classes (pounds per acre) 1/			
Soil associations	300-650	150-350	50-200	300-650	150-350	50-200	Brush removal and seeding, erosion-proofing of roads, gully plugs, consolidation of land ownership pattern, proper management and stocking.
B4-R10-L4	-----	3,000	-----	2,000	1,000	-----	
R13-L5-H7	500	900	-----	1,000	400	-----	
R13-L15-H7	10,100	4,700	9,800	15,000	8,400	1,200	
Subtotal	10,600	8,600	9,800	18,000	9,800	1,200	
4. Browse-aspen-conifer-grass; steep mountain slopes and basins	Production classes (pounds per acre) 1/			Production classes (pounds per acre) 1/			
	350-800	200-500	75-250	350-800	200-500	75-250	
L13-R16-Z	12,600	4,600	2,500	18,000	1,200	500	Erosion-proofing of roads, gully plugs, contour trenching, proper management and stocking.
R-13-L15-H7	1,400	1,200	5,100	4,000	2,800	900	
Subtotal	14,000	5,800	7,600	22,000	4,000	1,400	
Total 2/	30,700	29,300	112,300	93,600	60,800	17,900	

1/ These figures indicate total annual forage production, and will be used as a basis for planning needs only. Forage production figures will not be used for assigning range carrying capacities. These carrying capacities will depend upon such factors as slope, soil depth, soil character and stability, and the management objectives of the administrative agency.

These rates represent production variance from poor years to good years. At higher elevations within the site, with greater precipitation the rates would be higher, and conversely for lower elevations.

2/ Does not include 25,200 acres of barren or inaccessible land.

Source: Humboldt River Basin Field Party

Lamoille watershed. This information is arranged by vegetal type, site, and soil association. In general, the range in the fairly high forage production class is found in the browse-aspen-grass on the steep mountain slopes and basins of the Ruby and East Humboldt Ranges. Most of the range in the medium forage production class is found in the same vegetal site, with smaller acreages in the intermediate mountain slopes site. The bulk of the low range forage production class is found in the big sagebrush-grass vegetal site, on the upland benches and terraces. It is estimated that 65 percent of the range is in a low forage production class, 17 percent in medium, and 18 percent in the fairly high production class.

The intermingled private and Federal lands within the former railroad land grant make it difficult to achieve proper range and watershed management.

Opportunities for Development

Agricultural Water Management

The detail needed to develop the necessary data for calculating the quantities of structural measures is beyond the scope of this survey.

Lamoille Valley, and the adjacent drainages having a fairly good water supply, are among the better agricultural areas in the Humboldt Basin, and have an even greater potential. There are about 27,900 acres irrigated.

In the vicinity of the town of Lamoille, there are about 17,700 acres of cropland which could be benefited under a program of ditch consolidation and field ditch reorganization - 16,300 acres east of Lamoille Creek and 1,400 acres on the west side. With the high seepage loss from supply ditches, it is suggested that an improvement program be developed around the lining of supply ditches.

The following treatment measures would be necessary in order to obtain the maximum benefits from the water and related land resources:

1. Consolidate and line the main ditches.
2. Reorganize the irrigation systems.
3. Drain areas of high water table.
4. Level or smooth the fields according to soil and water limitations.
5. Plant high-yielding forage crops suitable to the site conditions.
6. Investigate possible ground water development for supplemental irrigation.
7. Clear stream channels of permanent obstructions.
8. Develop a program of water management.

Watershed Protection and Improvement

In order to protect the watershed, reduce erosion, and increase range forage production, the following minimum treatment measures are considered necessary:

1. Consolidate the national forest ownership pattern by a comprehensive land acquisition program for the intermingled private lands on the former railroad land grant northward from Lamoille Canyon.
2. Adjust domestic livestock and wildlife numbers to an indicated safe carrying capacity.
3. Improved management of sheep bands on the summer ranges. (Installation of deferred-rotation grazing, lighter or more uniform forage utilization, etc.)
4. Temporary closure of the Soldier Lake basin area to livestock use, to permit natural rehabilitation. Close the steep slopes at the heads of all three forks of Cold Creek to livestock use. Continue the closure of the Lamoille Canyon head to all classes of livestock. Close the drainage heads on Wright, Lemon's and Dry Creeks.
5. Construct about 35 miles of management unit and allotment fences on the Federal ranges.
6. Install erosion control measures on the sparsely vegetated slopes at the heads of Wright, Lemon's and Dry Creeks (see photograph 13).
7. Construct approximately 10 stockwater developments (probably wells).
8. Install channel stabilization measures in the heads of Soldier, Talbot, Conrad and Thomas Canyons. This treatment is also needed along the eroded channels of the lower Rabbit Creek tributaries and the middle reaches of Soldier, Secret, and John Day Creeks.
9. Treat all roads contemplated, in use, or abandoned, to prevent or stop erosion.
10. Range seeding on about 27,200 acres of Federal and private rangeland.
11. Brush overstory removal on about 5,000 acres of saline bottomlands.
12. Control sagebrush to thicken the grass understory by selective spraying on about 15,000 acres.

Benefits Expected

Agricultural Water Management

The proposed consolidation and lining of supply ditches would save water for other uses early in the irrigation season, and furnish additional water to more fields later in the season. In addition, fewer acres would need draining, and higher-yielding forage crops could grow. Other benefits expected from the treatment measures would include:

1. Better distribution and control of water on the land.
2. Better control of phreatophytes.
3. Higher irrigation efficiency.
4. Increased forage yields.
5. Better balance between summer grazing and winter feed.

Watershed Protection and Improvement

The land treatment and structural measures would result in better protection

Photograph 13 -- Sparsely vegetated and eroded area on Lemon's Creek headwaters, north of Secret Valley. FIELD PARTY PHOTO -- 6-635-10

for the watershed, reduce erosion, improve the range forage production, protect existing meadows and restore desiccated meadowlands, and reduce management problems. These benefits are reflected in terms of potential range forage improvements in table 9. It is estimated that the acreage of range land in a fairly high forage production class can be increased by 200 percent.

Conclusions

The proposed consolidation and lining of ditches would save needed water for other ranches early in the irrigation season and furnish additional water to more fields later in the season. In addition, fewer acres would need draining, and higher-yielding forage crops would be able to grow. The treatment measures suggested would help to provide better distribution of water, and the needed hay supply would be produced from fewer acres.

A program of watershed improvement measures as suggested would result in better protection for the watershed lands, reduce erosion, and improve the range forage production.

The total benefits from all structural and land treatment measures would be compared to the total costs. The preliminary evaluation indicated benefits in relation to costs favorable enough to warrant a more detailed study.

STARR VALLEY WATERSHED

Physical Features of the Watershed

Location

The Starr Valley watershed includes all the area northeast from the Secret Creek drainage to the sub-basin boundary west of Wells, Nevada, and between the crest of the East Humboldt Range and the bottomlands of the Humboldt River. The area covers about 138,800 acres of private and Federal lands.

Water Supply and Use

Surface Water

Runoff from the East Humboldt Range furnishes all the water that is used for irrigation. The annual gross water yield, 80 percent frequency, for this group of drainages is estimated to be 38,800 acre-feet, which includes the diverted water from Angel Lake, outside the Humboldt Basin. After leaving the mountains the water is used or lost as follows:

	Acres	Water use acre-feet
Irrigated crops	12,800	19,600
Discharge to the Humboldt River	------	17,500
Phreatophytes	1,400	1,700

There are no storage reservoirs in this area and no suitable site for a reservoir was found.

The canyon of Secret Creek and valleys of Lost Creek, Ackler Creek and adjacent tributaries north and south are potential areas of water loss to ground storage. Extensive thrust faulting and exposures of volcanic rock and limestone permit losses to surface flow in the vicinity of Secret Creek. In the vicinity of Ackler Creek exposures of limestone, conglomerate, quartzite and partially consolidated sediments, probably mostly glacial drift, may permit larger than normal losses to stream flow. Both of these areas warrant further study of possibilities for ground water development on adjacent lowlands.

Ground Water

There have been no known ground water investigations made in the watershed except on an individual site basis.

Ground water development in the area consists of one irrigation well with a capacity of about 800 g.p.m., and several low-capacity wells which are used for farmsteads and domestic livestock.

Water Needs For Recreation and Special Use Sites

The Angel Lake campsite is the only recreation development in the area at the present time. The Forest Service plans to enlarge the camp at Angel Lake, and develop a campsite on Clover Creek, west of Wells, Nevada. After all these improvements are installed, they will require about six-tenths of an acre-foot of water.

Soils and Geology

Elevations range from about 5,400 feet in Starr Valley to 10,566 feet in the East Humboldt Range.

The East Humboldt Range largely consists of complex metamorphic crystalline rocks, which include gneiss, gneissose granite, migmatite, partly quartzitic schist, amphibolite, and minor calc-silicate rocks and marble. Both broad up-arching and normal faulting have contributed to the uplifting of the East Humboldt Range. Partly consolidated Tertiary fluvial and lacustrine deposits underlie the valley floor. The pediments were developed over the Tertiary deposits in the uplands, and unconsolidated Quaternary alluvium overlies these deposits in the valley lowlands.

Soils above the 7,000 foot elevation are mostly excessively drained, stony and gravelly moderately coarse textured, and vary in depth from shallow to moderately deep over bedrock. There are considerable areas of rock outcrop, as well as some deep, gravelly medium textured soils in the canyon bottoms.

On the alluvial fans and terraces the soils are mostly moderately deep to deep, medium or stony medium textured, and well drained. There are some areas where a hardpan can be found at moderate depths.

The valley bottom soils are generally deep, medium to moderately fine textured, are moderately well to imperfectly drained, and may contain salt and alkali concentrations.

Vegetation

The vegetal cover has a general sagebrush aspect at the lower elevations, with mixed browse-aspen-grass at the higher elevations on the lands within the national forest. A few scattered clumps of limber pine are found in coves and basins high in the East Humboldt Range. Bluebunch wheatgrass, Idaho fescue, squirreltail, needlegrass, mountain brome, and Kentucky, Sandberg and Nevada bluegrass are found in these higher areas. They grow as an understory to the browse-aspen cover, in varying degrees of density. Cheatgrass forms an understory to the sagebrush aspect over much of the lower country.

Along lower Reed Creek and some of the streams draining the northern extremity of the East Humboldt Range, east of Deeth, channel cutting has dried out the former wet saline bottoms, and they have been invaded by rubber rabbitbrush, with a few areas of greasewood. A thin understory of Great Basin wildrye, squirreltail, Sandberg bluegrass, and cheatgrass, along with relatively worthless perennial and annual forbs, grows under and between the rabbitbrush. On the more saline sites, saltgrass dominates, with more greasewood in the browse overstory.

Land Status and Use

The land status and use is as shown below:

		Land Use					
Land Status	Acres	Range land		Irrigated land		Barren or inaccessible	
		Acres	%	Acres	%	Acres	%
National Forest	20,000	14,800	13	-----	---	5,200	55
National Land Reserve	23,200	23,200	20	-----	---	-----	--
County	300	300	--	-----	---	-----	--
Private	94,600	77,600	67	12,800	100	4,200	45
Total	138,100	115,900	100	12,800	100	9,400	100

The private land is divided among an estimated 37 owners. This includes approximately 1,000 acres belonging to the Southern Pacific Railroad.

Climate

The average annual precipitation is estimated to vary between a low of eight inches at Halleck, 9.5 inches at Deeth, 11 inches on Secret Creek, and 27 inches at Angel Lake. The growing season is estimated to be around 100 days in the agricultural areas (28 degrees F).

Watershed Problems

Agricultural Water Management

Seasonal distribution of irrigation water is limited to spring runoff periods, which normally last from the first of May to either the middle of June or the first of July, depending on the location and size of drainage.

A few of the ditches serve more than one ranch; however, the general practice is for each ranch to maintain a diversion in the creek channel for each field ditch. Seepage loss from the ditches is estimated to be between 20 and 30 percent.

All the native hay and pasture lands are irrigated by flooding, using a few gradient ditches to spread the water. Limited use has been made of the corrugation method of irrigation.

Agricultural water management problems which were found to be prevalent are:

1. Poor seasonal water distribution.
2. High seepage loss from ditches.
3. High water table.
4. Use of water supply to produce low-yielding crops.
5. Lack of adequate water control structures.
6. Low water use efficiency.

Flood Water, Erosion and Sediment Damage

No specific record of flood water, erosion or sediment damage accruing from any particular flood period, either wet or dry-mantle, has been found. However, over the years channel headcutting and meadow desiccation have progressed. This is evidenced by the fact there are approximately 12 miles of poor channel condition class on the upper reaches of most of the streams draining into Starr Valley from the East Humboldt Range (Dorsey, Reed, Stevens, First, Second and Third Boulder, Ackler and Herder Creeks).

Vegetation - Kind and Condition

Phreatophytes

Channel head-cutting has dried out the former saline bottoms along lower Reed Creek and the short drainages into the Humboldt east of Deeth. Rubber rabbitbrush, with an understory of saltgrass or wildrye, Sandberg bluegrass, and squirreltail, mixed with worthless forbs, has taken over. For the watershed as a whole, about 1,700 acre-feet of water are used by 1,400 acres of these phreatophytes (see table 10).

Range Forage Production

Table 11 gives range forage production acreage, present and potential, for the Starr Valley watershed. This information is arranged by vegetal type, site, and soil association. In general, the range in the fairly high forage production class is found in the browse-aspen-grass on the steep mountain slopes and basins of the East Humboldt Range, except for an extensive acreage of range seeding in the big sagebrush-grass site. Most of the range in the medium forage production class is found in the same vegetal site, with smaller acreages in the intermediate mountain slopes site. The bulk of the low range forage production class is found in the big sagebrush-grass vegetal site, on the upland benches and terraces. Surveys indicate that 82 percent of the range is in a low forage

Table 10. -- Phreatophyte acreage and annual ground water use, Starr Valley watershed, Ruby Mountains Sub-Basin 1/

Species	Height class	Density	Acreage cropland	Acreage range types 2/	Annual ground water use 2/ (feet)	Annual ground water use 2/ (acre-feet)
Cottonwood	15'+	.3-.4	-----	170	4.0	680
Willow	8-12'	.3-.4	-----	170	2.2	370
Rose	3-8'	.3-.4	-----	110	1.5	160
Rubber rabbitbrush	3'+	.05-.07	-----	870	.4	350
Saltgrass	-----	.05-.07	-----	60	.5	30
Great Basin wildrye	-----	.05-.07	-----	60	1.0	60
Total				1,440		1,650

1/ These values when referred to in the text are rounded.
2/ These values are based on natural stand densities and composition.

Source: Humboldt River Basin Field Party.

Table 11. -- Acreage classes of present and potential annual forage plant production classes, grouped by soil associations for each vegetal type and site, Starr Valley watershed.

Vegetal type and site	Present annual forage plant production classes (acres)			Potential annual forage plant production classes (acres)			Treatment needed to reach potential
1. Rabbitbrush-greasewood-grass; saline bottomlands	Production classes (pounds per acre) 1/			Production classes (pounds per acre) 1/			
Soil associations	850-1,500	200-900	20-300	850-1,500	200-900	20-300	
H5-A5-H6	-----	-----	1,500	500	500	500	Brush removal by blading, proper management and stocking.
H5-H9-H6	500	-----	2,800	2,500	500	300	
H6-H5	-----	-----	1,700	600	500	600	
Subtotal	500		6,000	3,600	1,500	1,400	
2. Big sagebrush-grass; upland benches and terraces	Production classes (pounds per acre) 1/			Production classes (pounds per acre) 1/			
Soil associations	250-600	100-450	20-150	250-600	100-450	20-150	
C6-B12	-----	-----	6,400	3,000	2,800	600	Brush removal and seeding, selective spraying, fencing stockwater development, erosion-proofing of roads, proper management and stocking.
C7-R10	-----	-----	4,700	2,500	2,000	200	
H5-H8-B9	800	-----	4,700	1,500	3,000	1,000	
S10-B9	12,500	-----	24,400	30,700	4,000	2,200	
S14-S12	-----	-----	4,000	1,000	2,000	1,000	
S15-Y1	100	-----	18,000	2,100	3,000	5,000	
Subtotal	13,400	-----	54,200	40,800	16,800	10,000	

Continued

Table 11. -- *Acreage classes of present and potential annual forage plant production classes, grouped by soil associations for each vegetal type and site, Starr Valley watershed -- Continued*

Vegetal type and site	Present annual forage plant production classes (acres)			Potential annual forage plant production classes (acres)			Treatment needed to reach potential
3. Browse-aspen-grass; intermediate mountain slopes	Production classes (pounds per acre) 1/			Production classes (pounds per acre) 1/			Erosion-proofing or elimination of some roads, build access roads to facilitate deer management, consolidation of land ownership pattern, adjust deer numbers, proper management and stocking of livestock.
Soil associations	300-650	150-350	50-200	300-650	150-350	50-200	
C7-L15-R13	-----	-----	7,100	3,000	3,000	1,100	
R13-L15-H7	-----	300	11,200	4,200	4,800	2,500	
Subtotal		300	18,300	7,200	7,800	3,600	
4. Browse-aspen-conifer-grass; steep mountain slopes and basins	Production classes (pounds per acre) 1/			Production classes (pounds per acre) 1/			Wyethia removal and seeding, fencing, erosion proofing or elimination of some roads, contour trenching, consolidation of land ownership pattern, proper management and stocking.
Soil associations	350-800	200-500	75-250	350-800	200-500	75-250	
L13-R16-Z	-----	6,800	16,400	10,800	10,000	2,400	
Subtotal	-----	6,800	16,400	10,800	10,000	2,400	
Total 2/	13,900	7,100	94,900	62,400	36,100	17,400	

1/ These figures indicate total annual forage production, and will be used as a basis for planning needs only. Forage production figures will not be used for assigning range carrying capacities. These carrying capacities will depend upon such factors as slope, soil depth, soil character and stability, and the management objectives of the administrative agency. These rates represent production variance from poor years to good years. At higher elevations within the site, with greater precipitation the rates would be higher, and conversely for lower elevations.

2/ Does not include 9,400 acres of barren or inacessible land.

Source: Humboldt River Basin Field Party

production class, six percent in the medium, and 12 percent is in the fairly high production class. The intermingled private and Federal lands within the former railroad land grant make it difficult to achieve proper range and watershed management.

Lack of public-access roads to the national forest areas through the private lands below is leading to an overlarge deer herd buildup, primarily because of lack of hunter pressure.

Opportunities for Development

Agricultural Water Management

The detail needed to develop the necessary data for calculating the quantities of structural measures is beyond the scope of this survey.

There are about 3,100 acres of cropland irrigated from Ackler and Herder Creeks which could benefit under a program of ditch consolidation and field ditch reorganization. With the high seepage loss from supply ditches, it is suggested that an improvement program be developed around the lining of supply ditches.

In the watershed there is a total of 12,800 acres of irrigated hay and pasture land. The following treatment measures would be necessary in order to obtain the maximum benefits from the water and related land resources:

1. Consolidate and line the main ditches around Ackler and Herder Creeks.
2. Reorganize the irrigation systems.
3. Drain areas of high water table.
4. Level or smooth the fields according to soil and water limitations.
5. Plant high-yielding forage crops suitable to the site conditions.
6. Investigate possible ground water development for supplemental irrigation.
7. Clear stream channels of permanent obstructions.
8. Develop a program of water management.

Watershed Protection and Improvement

In order to protect the watershed, reduce erosion, and increase range forage production, the following minimum treatment measures are considered necessary:

1. Consolidate the national forest and national land reserve ownership pattern by a comprehensive land acquisition program for the intermingled private lands on the former railroad land grant lands.

2. Adjust domestic livestock and wildlife numbers to an indicated safe carrying capacity.
3. Improved management of sheep bands on the summer ranges. (Installation of rest-rotation grazing in the head of Dorsey Creek; lighter or more uniform forage utilization over all the summer range.)
4. Closure to livestock use of the heads of all four forks of Boulder Creek, and the flats at the head of Dorsey Creek, to aid vegetal recovery in the depleted upper basins of these drainages.
5. Construct needed stockwater developments.
6. Plough and seed to adapted species 7,000 acres of sagebrush land on the national land reserve (Dennis Flat).
7. Install erosion control measures and seed the sparsely vegetated slopes at the head of the north fork of Ackler Creek (600 acres) and approximately 200 acres in the heads of First to Third Boulder Creeks.
8. To implement the reduction of deer numbers to an indicated safe carrying capacity, open the national forest lands to heavier hunter use through the securing of rights-of-way and construction of public access roads. (Lower Reed, Stevens, Ackler, Herder, Smiley, and Trout Creeks).
9. Install channel stabilization measures along lower Reed Creek.
10. Retire and erosion-proof the primitive roads in Herder Creek basin in the national forest, north of the middle fork of Herder Creek.
11. Erosion-proof the upper mile of the four-wheel drive road in the head of Dorsey Creek. Treat all other roads contemplated, in use, or abandoned in the watershed, to prevent or stop erosion.
12. Selective spraying of 7,000 acres of sagebrush, to control the brush and thicken the grass understory, upper east side of Dennis Flat.
13. Spray 200 acres of mule's ear dock at the head of Dorsey Creek, and seed the area with adapted grass species.

Benefits Expected

Agricultural Water Management

The proposed consolidation and lining of supply ditches would save water for other uses early in the irrigation season, and furnish additional water to more fields later in the season. In addition, fewer acres would need draining, and higher-yielding forage crops could grow. Other benefits expected from the treatment measures would include:

1. Better distribution of water
2. Better control of phreatophytes.
3. Higher irrigation efficiency.
4. Increased forage yield.
5. Better balance between summer grazing and winter feed.

Watershed Protection and Improvement

The land treatment and structural measures would result in protection and rehabilitation of the watershed, reduce erosion, improve the range forage production, protect existing meadows, restore desiccated meadowlands, and reduce management problems. These benefits are reflected in terms of potential range forage production in table 11. It is estimated that the acreage of range land in a fairly high forage production class can be increased by 350 percent.

Conclusions

The proposed consolidation and lining of ditches would save needed water for other lands early in the irrigation season and furnish additional water to more fields later in the season. In addition, fewer acres would need draining, and higher-yielding forage crops would be able to grow. The treatment measures suggested would help to provide better distribution of water and the needed hay supply would be produced from fewer acres.

A program of watershed protection and range improvement measures as suggested would result in better protection for the watershed lands, reduce erosion, and improve the range forage production.

The total benefits from all structural and land treatment measures would be compared to the total costs. The preliminary evaluation indicated benefits in relation to costs favorable enough to warrant a more detailed study.

The generalized soil survey of the Ruby Mountains Sub-Basin shows the location and distribution of different kinds of soils by associations of Great Soil Groups. Each Great Soil Group includes a number of soils with similar internal characteristics that reflect the environmental conditions responsible for their development. Great Soil Groups mapped in the survey include:

Alluvial Soils (Symbol: A)

These are the soils that consist of essentially recent stream-laid deposits: alluvial fans, floodplains, terraces and basins. They have essentially no profile development, but a little organic matter may have accumulated. They are usually deep, stratified, variable with regard to drainage class, and occur under many different climates.

Brown Soils (Symbol: B)

These are the soils which have dark brownish A horizons about six inches thick, textural B Horizons 10 to 15 inches thick, and calcareous parent material of variable thickness. Some of these soils have cemented calcium carbonate layers in the C horizon and some may have the C horizon resting on bedrock. They are usually moderately deep to deep, well drained, and occur under a cool semi-arid climate with an average precipitation of 10 to 14 inches. Most of the Brown Soils in the Ruby Mountains Sub-Basin occur at elevations above 5,000 feet, in the uplands.

Chestnut Soils (Symbol: C)

These soils have dark grayish brown to very dark grayish brown A horizons about six to eight inches thick, textural B horizons 10 to 15 inches thick, and parent material that may or may not be calcareous. These soils usually have darker A horizons, more organic matter, and have been more strongly leached than have the Brown Soils. The parent material may or may not rest on bedrock. They are usually moderately deep to deep, well drained, and occur in a cool semi-arid climate with an average precipitation of about 14 to 18 inches. Most of the Chestnut Soils in the Ruby Mountains Sub-Basin occur at elevations above 5,500 feet, in the uplands.

Calcisols (Symbol: G)

These soils occur on highly calcareous parent material in the arid and semi-arid regions. They have developed where leaching is limited, but have formed under good to excessive drainage conditions. They include soils in which the calcium carbonate has accumulated to form a prominent Cca on Dca horizon near the lower depth of wetting. They have a light gray-brown A or A1 horizon, about 10 to 15 inches thick, which becomes lighter colored with depth. They are moderately deep, well drained, and occur with an average annual precipitation of about eight to 12 inches at elevations below 7,000 feet.

Humic Gley Soils (Symbol: H)

These are the dark brown or black meadow soils that grade into lighter colored or rust-mottled grayish soil at depths of one to two feet. They are imperfectly to poorly drained, usually with seasonal fluctuating high water table, and occur along stream floodplains where they are subject to overflow. They occur in a cool semi-arid climate, and are found in the Ruby Mountains Sub-Basin at elevations mostly below 6,000 feet.

Lithosols (Symbol: L)

These soils have an incomplete profile, or no clearly expressed morphology. They are shallow (less than 10 to 15 inches), and consist of freshly and imperfectly weathered masses of hard rock or hard rock fragments, and are largely confined to steeply sloping lands. In the higher rainfall areas of the sub-basin, some of these soils may have dark A horizons. They are usually excessively drained.

Regosols (Symbol: R)

These are soils which consist of deep unconsolidated deposits, in which few or no clearly expressed soil characteristics have developed. They are largely confined to colluvial accumulations on steep mountain slopes. Under eight to 10 inch rainfall the Regosols may have only a weekly developed A horizon, while in higher rainfall areas they may have well developed dark A horizons six to 14 inches or more thick. In mountainous areas these soils may be underlain by bedrock 15 to 20 inches below the soil surface.

Sierozems (Symbol: S)

These are soils with a pale grayish or light brownish surface and textural B horizons closely related in color to the surface soil. They are usually calcareous in the B horizon, and frequently also in the surface soil. They quite often have a cemented calcium carbonate hardpan at shallow to moderate depths below the B horizon. The B horizon in the Sierozem Soils in this sub-basin is usually weakly developed and difficult to identify. In mountainous areas the Sierozems may be underlain by bedrock at moderate depths. These soils are found in a semi-arid cool climate, with an average annual precipitation of about eight to 10 inches, and mostly at elevations below 6,000 feet.

Solonetz (Symbol: Y)

These are imperfectly drained soils with a very few inches of light grayish or brownish surface soil underlain by a hard columnar fine-textured horizon that is high in exchangeable sodium. They occur on floodplains, terraces, and some alluvial fans, usually as small areas associated with saline-alkali Alluvial Soils, Humic Gley Soils, and Calcium Carbonate Solonchaks.

Rockland (Symbol: Z)

These are essentially non-soil areas, consisting of hard rock and hard rock fragments of granite, limestone and lava formations, which are extremely steep and inaccessible to livestock. They occur as outcrops, bluffs and cliffs with some talus areas below. Little or no weathering has taken place for soil formation. Vegetation on these areas is limited to natural fractures in the rock or small areas of deposited soil material.

Mapping Units

Mapping units on the generalized soil survey map of the Ruby Mountains Sub-Basin are associations of phases of Great Soil Groups that reflect characteristics of soils significant to use and management. Each mapping unit symbol includes the designation of approximate composition for each Great Soil Group that comprises the association.

Example: $\frac{\text{L1-C1-R1}}{\text{60-20-20}}$

SOILS TABLES

The following tables, 12 and 13, show the general soil characteristics and the interpretations for each great soil group phase which was mapped in the sub-basin.

Table 12 -- Soil Characteristics, Ruby Mountains Sub-Basin

Soil Phase	Depth	Texture: Surface	Texture: Subsoil	Slope Range %	Erosion	Salt & alkali	Drainage	Remarks
A5	Deep	Medium	Medium	0-2	Slight	None to slight	Mod. well to well	20% seedable 10% overflowed some gullying
A6	Deep	Medium to moderately fine	Medium to moderately fine	0-2	Slight	Mod. to strong	Imperfect to poor	
B4	Deep	Stony medium moderately fine	Moderately fine to fine	20-40	Slight 10% mod.	None	Well	5% Chestnut 5% Sierozem
B6	Moderately deep over pan	Medium	Fine	3-10	Slight 5% sev.	None	Well	10% stony soils 60% seedable
B7	Moderately deep to deep	Moderately coarse	Moderately fine	10-30	Moderate 10% sev.	None	Well	
B8	Moderately deep to deep	Medium	Moderately fine	10-30	Moderate 10% sev.	None	Well	
B9	Deep	Medium	Fine	3-10	Slight	None	Well	5% imperfectly drained, irrigated soils, 80% seedable.
B12	Moderately deep to deep	Medium, stony and very stony medium	Medium, moderately fine to fine	4-30	Slight 10% mod.	None	Well	25-30% stony soils 10% deep (over 36")
C3	Moderately deep over bedrock	Medium and stony medium	Moderately fine to fine	10-30 10-30	Slight 5% mod.	None	Well	
C6	Moderately deep over bedrock	Medium and stony medium	Moderately fine to fine	10-30	Slight 5% mod.	None	Well	

Continued

Table 12 -- Soil Characteristics, Ruby Mountains Sub-Basin -- Continued

Soil Phase	Depth	Texture: Surface	Texture: Subsoil	Slope Range %	Erosion	Salt & alkali	Drainage	Remarks
C7	Moderately deep to deep	Stony medium and medium	Medium to moderately fine	10-30	Slight 15% mod.	None	Well	10% very stony 10% deep Chestnut soils
G1	Moderately deep over hardpan	Medium and gravelly medium	Medium and gravelly medium	3-10	Slight 20% mod. 10% sev.	None	Well	10% stony soils 40% seedable
H5	Deep	Medium and moderately fine	Medium and moderately fine	0-2	Slight	None	Imperfect to poor	Overflowed
H6	Deep	Medium and moderately fine	Medium and moderately fine	0-2	Slight	Slight to mod.	Imperfect to poor	Overflowed
H7	Deep	Gravelly medium and very gravelly medium	Gravelly medium and very gravelly medium	10-30	Moderate 10% sev.	None	Imperfect to poor	Overflowed 15% stony and very stony soils
H8	Moderately deep over hardpan	Medium	Medium to medium fine	3-10	Slight	None	Imperfect to mod. well	
H9	Deep	Fine	Fine	0-3	Slight	None to slight	Imperfect to poor	Overflowed 15% non-saline alkali, 15% Calcium Carbonate Solonchak
L1	Shallow over bedrock	Stony and rocky medium		50-70	Slight 20% mod.	None	Excessive	
L4	Shallow over bedrock	Stony and gravelly medium		30-60	Slight	None	Excessive	
L5	Shallow over bedrock	Very gravelly stony moderately coarse		30-60	Moderate 10% sev.	None	Excessive	10% rockland

Continued

Table 12 -- Soil Characteristics, Ruby Mountains Sub-Basin -- Continued

Soil Phase	Depth	Texture: Surface	Texture: Subsoil	Slope range %	Erosion	Salt & alkali	Drainage	Remarks
L6	Shallow over bedrock	Stony and gravelly medium		20-30	10% mod. Slight	None	Excessive	10% rockland
L7	Shallow over bedrock	Stony and gravelly medium		50-75	Moderate 20% sev.	None	Excessive	10% rockland
L8	Shallow over bedrock	Stony and gravelly moderately coarse and coarse		50-75+	Moderate 20% sev.	None	Excessive	10% rockland
L9	Shallow over soft sedimentary rock	Medium		30-60	Severe 10% very severely	None	Excessive	
L13	Shallow over bedrock	Stony and gravelly moderately coarse and coarse		50-75+	Moderate 20% sev.	None	Excessive	
L15	Shallow over bedrock	Stony and rocky medium		30-50	Slight 15% mod.	None	Excessive	10% rock outcrop
R10	Deep	Gravelly and stony medium	Medium	40-60	Slight 20% mod.	None	Somewhat excessive	
R11	Deep	Stony medium	Medium	40-60	Slight 10% mod.	None	Somewhat excessive	10% rock outcrop and very stony
R12	Moderately deep to deep	Very gravelly and stony medium	Very gravelly & stony med.	50-65	Slight 20% mod.	None	Somewhat excessive	
R13	Moderately deep over bedrock	Stony medium	Stony medium	30-60	Moderate 10% sev.	None	Somewhat excessive	10% rockland

Continued

Table 12 -- Soil Characteristics, Ruby Mountains Sub-Basin -- Continued

Soil Phase	Depth	Texture: Surface	Texture: Subsoil	Slope range %	Erosion	Salt & alkali	Drainage	Remarks
R14	Moderately deep over bedrock	Stony and gravelly moderately coarse	Stony and gravelly moderately coarse	30-60	Moderate 10% sev.	None	Somewhat excessive	
R15	Shallow to mod. deep over soft sedimentary rock	Medium	Moderately fine	10-30	Severe 10% sev.	None	Somewhat excessive	
R16	Moderately deep over bedrock	Stony and gravelly moderately coarse	Stony and gravelly moderately coarse	30-60	Moderate 10% sev.	None	Somewhat excessive	
S8	Moderately deep	Gravelly medium	Gravelly medium	20-40	Moderate	None	Well	10% stony soils
S10	Moderately deep over hardpan	Medium	Moderately fine	10-30	Slight 15% mod.	None	Well	50% seedable
S11	Moderately deep over hardpan	Medium	Moderately fine	3-10	Slight	None	Well	5% saline-alkali Solonetz 60% seedable
S12	Moderately deep over hardpan	Medium and moderately coarse	Moderately fine	10-30	Moderate	None	Well	50% seedable
S13	Deep	Medium	Fine	10-30	Slight 20% mod.	None	Well	60% seedable
S14	Moderately deep over soft sedimentary rock	Gravelly medium and coarse	Gravelly medium and coarse	30-60	Moderate 10% sev.	None	Well	

Continued

Table 12 -- Soil Characteristics, Ruby Mountains Sub-Basin -- Continued

Soil Phase	Depth	Texture: Surface	Texture: Subsoil	Slope range %	Erosion	Salt & alkali	Drainage	Remarks
S15	Deep	Medium	Medium	3-10	Moderate 10% sev.	None	Well	75% seedable
S16	Deep	Medium	Medium	3-10	Moderate 10% sev.	Slight	Well	
Y1	Deep	Medium and moderately fine	Moderately fine to fine	0-3	Slight 5% sev.	Moderate to strong	Imperfect to mod. well	
Z	Rockland	------	-------	----	----	----	------	

SOURCE: HUMBOLDT RIVER BASIN FIELD PARTY

Table 13 -- Interpreted soil characteristics, Ruby Mountains Sub-Basin

Soil Phase	Precip. zone (inches)	Erosion hazard	AWHC 1/ (inches)	Soil Hydrologic Group	Capability subclass	Major land use	Dominant vegetation
A5	8-12	Slight	9	C	IIw VIc	Irrigated crops and range	Shadscale - budsage - greasewood - grass
A6	8-12	Slight	12	D	VIIs	Range	Greasewood - saltgrass, rabbitbrush-saltgrass
B4	8-12	Slight	8	C	VIIs	Range	Big sage-grass
B6	10-14	Slight	6	C	VIs	Range	Big sage - grass, juniper - grass
B7	10-16	Severe	6	C	VIIs	Range	Big sage-grass
B8	10-14	Moderate	6	C	VIIs	Range	Big sage - grass
B9	10-16	Moderate	8	C	VIIs	Range	Big sage - grass
B12	10-18	Moderate	8	C	VIc VIIc	Range	Big sage - grass
C3	10-12	Slight	6	C	VIIe	Range	Big sage - grass
C6	10-18	Slight	6	C	VIIe	Range	Big sage - grass
C7	10-14	Moderate	6	C	VIIe	Range	Big sage - bitterbrush - grass
G1	8-12	Moderate	5	D	VIc	Range	Big sage - grass
H5	8-18	Slight	10	B	IIIw	Meadow hayland and pasture	Meadow grass
H6	8-14	Slight	10	B	IVw VIw	Range and meadow	Rabbitbrush, giant wildrye, saltgrass
H7	12-25	Severe	8	B	VIw	Range, watershed, recreation	Mixed browse - weeds, grass-weeds
H8	10-14	Moderate	8	C	IVw	Meadow hayland	Meadow grass
H9	8-10	Slight	8	D	IVw	Range and meadow hayland	Rabbitbrush-giant wildrye, rabbitbrush - greasewood - saltgrass

Continued

Table 13 -- Interpreted soil characteristics, Ruby Mountains Sub-Basin -- Continued

Soil Phase	Precip. zone (inches)	Erosion hazard	AWHC 1/ (inches)	Soil Hydro-logic Group	Capa-bility subclass	Major land use	Dominant vegetation
L1	8-18	Moderate	1.5	D	VIIs	Range and watershed	Low sage - grass
L4	10-12	Slight	1.5	D	VIs	Range and woodland	Big sage - grass, juniper - grass
L5	12-25	Severe	1.5	D	VIIs	Range and woodland	Big sage - grass, juniper - grass
L6	8-10	Severe	1.5	D	VIIs	Range	Big sage - grass, juniper - grass
L7	14-18	Severe	1.5	D	VIIs	Range	Juniper - grass
L8	15-25	Severe	1.5	D	VIII	Range, watershed, recreation	Juniper, mixed browse with pine
L9	10-14	Very severe	1.5	D	VIIs	Range	Juniper - grass
L13	25-45	Severe	1.5	D	VII	Range, watershed, recreation	Mixed browse
L15	12-25	Moderate	1.5	D	VIIs	Range	Low sage - grass
R10	8-14	Moderate	7	C	VIIe	Range	Big sage - grass, juniper - grass
R11	10-18	Moderate	7	C	VIIe	Range	Big sage - grass
R12	10-14	Severe	4	C	VIIe	Range	Big sage - grass
R13	12-25	Severe	4	C	VIIe	Range	Big sage - grass, mixed browse
R14	15-25	Severe	4	C	VIII	Range, watershed, recreation	Big sage - grass, mixed browse
R15	10-14	Very severe	4	D	VIIe	Range	Juniper - grass
R16	25-45	Severe	4	C	VIII	Range, watershed recreation	Big sage - grass, mixed browse
S8	8-12	Slight	4	D	VIIe	Range	Big sage - grass
S10	8-12	Moderate	7	C	VIc	Range	Big sage - grass
S11	8-10	Moderate	7	C	VIc	Range	Big sage - grass, juniper - grass

Continued

Table 13 -- Interpreted soil characteristics, Ruby Mountains Sub-Basin -- Continued

Soil Phase	Precip. zone (inches)	Erosion hazard	AWHC 1/ (inches)	Soil Hydro-logic Group	Capa-bility subclass	Major land use	Dominant vegetation
S12	8-10	Severe	6	C	VIIe	Range	Big sage - grass
S13	8-10	Moderate	8	C	VIc	Range	Big sage - grass
S14	8-10	Severe	7	D	VIIe	Range	Big sage - grass
S15	8-10	Moderate	8	B	VIc VIIc	Range	Big sage - grass
S16	8-10	Moderate	8	C	VIc VIIc	Range	Shadscale, budsage, big sage-grass
Y1	8-10	Slight	12	D	VIIs	Range, small amounts of cropland	Greasewood - saltgrass
Z	Rockland	-----	-----	----	-----	------	--------

1/ Available water holding capacity.

Source: Humboldt River Basin Field Party

DEFINITIONS

HYDROLOGIC SOIL GROUP

Watershed soil determinations are used in the preparation of hydrologic soil cover complexes, which in turn are used in estimating direct runoff. Four major soil groups are used. The soils are classified on the basis of intake of water at the end of long-duration storms occurring after prior wetting and opportunity for swelling and without the protective effects of vegetation.

Group A - Soils haveing high infiltration rates even when thoroughly wetted, consisting chiefly of deep, well to excessively well drained sand or gravel. These soils have a high rate of water transmission and would result in a low runoff potential.

Group B - Soils having moderate infiltration rates when thoroughly wetted, consisting chiefly of moderately deep to deep, moderately well to well drained soils with moderately fine to moderately coarse textures. These soils have a moderate rate of water transmission.

Group C - Soils having slow infiltration rates when thoroughly wetted, consisting chiefly of (l) soils with a layer that impedes the downward movement of water; of (2) soils with moderately fine to fine texture and slow infiltration rate. These soils have a slow rate of water transmission.

Group D - Soils having very slow infiltration rates when thoroughly wetted, consisting chiefly of (1) clay soils with a high swelling potential; (2) soils with a high permanent water table; (3) soils with a claypan or clay layer at or near the surface; and (4) shallow soils over nearly impervious materials. These soils have a very slow rate of water transmission.

LAND USE CAPABILITY CLASSES AND SUBCLASSES

The capability classification is a practical grouping of soils. Soils and climate are considered together as they influence use, management, and production on the farm or ranch.

The classification contains two general divisions: (1) land suited for cultivation and other uses; and (2) land limited in use and generally not suited for cultivation. Each of these broad divisions has four classes which are shown by a number. The hazards and limitations in use increase as the class number increases. Class I has few hazards or limitations, or none, whereas Class VIII has a great many.

Capability classes are divided into subclasses. These show the principal kinds of conservation problems involved. The subclasses are "e" for erosion, "w" for wetness, "s" for soil, and "c" for climate.

Capability classes and subclasses, in turn, may be divided into capability units. A capability unit contains soils that are nearly alike in plant growth and in management needs.

Land Suited for Cultivation and Other Uses

Class I — Soils in Class I have few or no limitations or hazards. They may be used safely for cultivated crops, pasture, range, woodland or wildlife.

Class II — Soils in Class II have few limitations or hazards. Simple conservation practices are needed when cultivated. They are suited to cultivated crops, pasture, range, woodland, or wildlife.

Class III — Soils in Class III have more limitations and hazards than those in Class II. They require more difficult or complex conservation practices when cultivated. They are suited to cultivated crops, pasture, range, woodland, or wildlife.

Class IV — Soils in Class IV have greater limitations and hazards than Class III. Still more difficult or complex measures are needed when cultivated. They are suited to cultivated crops, pasture, range, woodland, or wildlife.

Class V — Soils in Class V have little or no erosion hazard but have other limitations that prevent normal tillage for cultivated crops. They are suited to pasture, woodland, range, or wildlife.

Class VI — Soils in Class VI have severe limitations or hazards that make them generally unsuited for cultivation. They are suited largely to pasture, range, woodland, or wildlife.

Class VII — Soils in Class VII have very severe limitations or hazards that make them generally unsuited for cultivation. They are suited to grazing, woodland, or wildlife.

Class VIII — Soils and land forms in Class VIII have limitations and hazards that prevent their use for cultivated crops, pasture, range, or woodland. They may be used for recreation, wildlife, or water supply.

ANNUAL WATER BALANCE STUDY - 80% FREQUENCY

Annual water balance is defined for these studies as the portion of the hydrologic cycle which starts with precipitation on the watershed, and ends with runoff (both surface and subsurface) after subtracting water uses and losses.

The annual water balance was calculated for an 80 percent frequency (expected to be equaled or exceeded eight out of 10 years). This frequency was used because normally such a water supply would be the quantity needed to justify land and irrigation improvements on ranches growing high-yielding crops.

Values obtained using this procedure are approximations. Accuracy would depend on the reliability of the basic soils, vegetation, and hyrologic data used, but would probably be in the range of 60 to 90 percent.

The available information for determining precipitation in the watershed areas above 6,000 feet consisted of snow survey records from 14 stations and storage gage precipitation data from six stations. These data gave an indication of the annual precipitation. The precipitation used in the water balance studies was determined as the quantity needed to produce the 80 percent frequency flow at the stream gaging stations after subtracting the different uses and losses. In order to keep the indicated and final precipitation in fairly close agreement it was necessary, in some cases, to analyze such things as rock formations for losses or gains in water, and gaging stations for underflow and overflow.

Flow diagrams of water yields and depletions, with quantities in acre-feet, are shown in figures 1 and 2. Tables 14 and 15 are a summary of the water balance studies by elevation zones for watersheds. The difference in water yield, inches per acre, is caused by the difference in watershed characteristics. These characteristics include difference in (1) precipitation; (2) soil development; (3) condition and species of plant cover; and (4) to some extent, the difference in size and location of the drainage.

The annual water balance calculations by watersheds were made to find answers to the following questions:

1. What is the gross water yield of the watersheds in the sub-basin? Gross water yield is considered to be the available water prior to irrigation and phreatophyte use.

2. What is the approximate magnitude of water use and loss by each of the major ground cover types?

3. Where are the water-yielding areas in the sub-basin and in each watershed?

Table 14 -- *Summary of Water Balance Studies by elevation zones for the South Fork of the Humboldt River watersheds in the Ruby Mountains Sub-Basin, for an 80% frequency* 1/

Elevation: zone (feet)	Upper Huntington Creek: Acres	Upper Huntington Creek: Water Yield in./ac.	Upper Huntington Creek: Water Yield acre-feet	West Huntington: Acres	West Huntington: Water Yield in./ac.	West Huntington: Water Yield acre-feet	East Huntington: Acres	East Huntington: Water Yield in./ac.	East Huntington: Water Yield acre-feet
10-11,000	-----	----	------	-----	---	-----	690	9.39	540
9-10,000	130	7.38	80	-----	---	-----	5,600	7.05	3,290
8- 9,000	3,150	5.14	1,350	80	4.50	30	11,200	4.52	4,220
7- 8,000	15,710	2.28	2,990	8,180	2.13	1,450	16,250	2.14	2,900
6- 7,000	63,640	.26	1,460	62,610	.23	1,200	33,240	.22	750
5- 6,000	23,170	----	- 180	73,630	---	-280	70,720	----	-1,030
Total	105,800		5,700	144,500		2,400	137,700		10,670
Gross Water Yield			5,700			2,400			10,670
Inflow:			-----			-----	Upper Huntington		2,820
			-----			-----	West Huntington		2,400
Use : Irrigated cropland			-----			-----			-3,160
Preatophytes			-880			-----			-2,310
Losses: Assumed outflow from							Assumed outflow from		
Humboldt River Basin			-2,000			-----	Humboldt River Basin		-8,200
Discharge to Huntington Creek			2,820			2,400			2,220

Continued

Table 14 -- Summary of Water Balance Studies by elevation zones for the South Fork of the Humboldt River watersheds in the Ruby Mountains Sub-Basin, for an 80% frequency Continued 1/

Elevation zone (feet)	Smith Creek			Upper South Fork			Tenmile Creek		
		Water Yield			Water Yield			Water Yield	
	Acres	in./ac.	acre-feet	Acres	in./ac.	acre-feet	Acres	in./ac.	acre-feet
10-11,000	1,040	15.58	1,350	4,330	23.86	8,610	380	28.11	890
9-10,000	4,250	12.48	4,420	12,980	19.03	20,580	980	22.40	1,830
8- 9,000	8,800	7.45	5,470	11,820	13.30	13,100	1,670	16.02	2,230
7- 8,000	21,880	4.32	7,870	8,730	8.14	5,920	2,370	8.61	1,700
6- 7,000	31,510	----	940	12,300	---	630	10,840	.54	570
5- 6,000	57,820	----	-130	20,240	---	----	103,960	---	-410
Total	125,300		19,920	70,400		48,840	120,200		6,810
Gross Water Yield			19,920			48,840			6,810
Inflow: East Huntington			2,220			----	Springs		730
Use: Irrigated cropland			-8,630			-8,870			-5,730
Phreatophytes			-1,110			-3,330			-950
Losses: Assumed outflow from Humboldt River Basin			-----			-----			-----
Discharge to South Fork			12,400			36,640			860

Continued

Table 14 -- *Summary of Water Balance Studies by elevation zones for the South Fork of the Humboldt River watersheds in the Ruby Mountains Sub-Basin, for an 80% frequency Continued* 1/

Elevation zone (feet)	Dixie Creek: Acres	Dixie Creek: Water Yield in./ac.	Dixie Creek: Water Yield acre-feet		Lower South Fork Bottom: Acres	Lower South Fork Bottom: Water Yield in./ac.	Lower South Fork Bottom: Water Yield acre-feet
10-11,000	-----	-----	-----		----	---	-----
9-10,000	-----	-----	-----		----	---	-----
8- 9,000	1,150	3.86	370		----	---	-----
7- 8,000	6,820	2.30	1,310		----	---	-----
6- 7,000	48,020	.37	1,470		----	---	-----
5- 6,000	74,810	-----	-720		2,800	---	-----
Total	130,800		2,430		2,800	---	-----
Gross Water Yield			2,430				-----
Inflow:			-----	Smith Creek			12,400
			-----	Upper South Fork			36,640
			-----	Tenmile Creek			860
			-----	Dixie Creek			2,030
Use: Irrigated cropland			-260				-1,270
Phreatophytes			-140				-----
Losses:			-----				-----
Discharge to South Fork			2,030	Discharge to Humboldt River			50,660

1/ Values quoted in the text of the report are rounded to the nearest 100 acre-feet.

Source: Humboldt River Basin Field Party.

Table 15 -- Summary of Water Balance Studies by elevation zones for the Lamoille, Upper Lamoille Creek, Secret-Soldier Creek, Starr Valley, and Rabbit Creek watersheds in the Ruby Mountains Sub-Basin, for an 80% frequency 1/

Elevation zone (feet)	Willow Creek Acres	Willow Creek Water Yield in./ac.	Willow Creek Water Yield acre-feet	Starr Acres	Starr Water Yield in./ac.	Starr Water Yield acre-feet	Rabbit Creek Acres	Rabbit Creek Water Yield in./ac.	Rabbit Creek Water Yield acre-feet
10-11,000	100	20.40	170	1,920	23.69	3,790	690	27.83	1,600
9-10,000	1,310	19.14	2,090	6,550	19.12	10,440	1,030	22.48	1,930
8- 9,000	2,500	13.44	2,800	8,860	13.37	9,870	900	15.72	1,180
7- 8,000	3,300	7.89	2,170	8,620	7.96	5,720	770	7.79	500
6- 7,000	10,990	1.00	920	13,610	.78	890	2,300	----	150
5- 6,000	35,900	-----	-80	44,440	----	-----	61,610	----	----
Total	54,100		8,070	84,000		30,710	67,300		5,360
Gross Water Yield			8,070			30,710			5,360
Inflow: Angel Lake Yield included in Willow Cr.			----			------	Diverted from Lamoille Creek		160
Use : Irrigated cropland			-7,080			-12,530			-4,120
Phreatophytes			-480			-1,170			-650
Losses:			-----			------			
			-----			------	Assumed underground flow to Tenmile Creek		-730
Discharge to Humboldt River			510			17,010			20

Continued

Table 15 -- Summary of Water Balance Studies by elevation zones for the Lamoille, Upper Lamoille Creek, Secret-Soldier Creek, Starr Valley, and Rabbit Creek watersheds in the Ruby Mountains Sub-Basin, for an 80% frequency Continued 1/

Elevation zone (feet)	Upper Lamoille Creek: Acres	Upper Lamoille Creek: Water Yield in./ac.	Upper Lamoille Creek: Water Yield acre-feet	Secret-Soldier Creek: Acres	Secret-Soldier Creek: Water Yield in./ac.	Secret-Soldier Creek: Water Yield acre-feet	Lamoille: Acres	Lamoille: Water Yield in./ac.	Lamoille: Water Yield acre-feet
10-11,000	2,460	27.95	5,730	130	24.00	260	2,050	23.76	4,060
9-10,000	5,770	22.50	10,820	2,700	18.93	4,260	6,090	18.91	9,600
8- 9,000	4,680	15.87	6,190	6,030	13.37	6,720	8,350	13.14	9,140
7- 8,000	2,970	8.16	2,020	10,440	6.23	5,420	7,730	6.08	3,920
6- 7,000	820	1.76	120	19,980	.13	1,430	13,230	-----	240
5- 6,000	-----	-----	-----	28,520	----	-130	36,150	-----	-----
Total	16,700		24,880	67,800		17,960	73,600		26,960
Gross Water Yield			24,880			17,960			26,960
Inflow:			------			-----	Upper Lamoille Creek		24,880
			------			-----	Secret-Soldier Creek		7,210
			------			-----	Warm Springs		3,650
Use : Irrigated cropland			------			-9,930			-26,160
Phreatophytes			------			-820			-3,920
Losses:			------			------	Diversion to Rabbit Creek		-160
Discharge to Lamoille Creek			24,880	To Lamoille Creek		7,210	To Humboldt River		32,460

1/ Values quoted in the text of the report are rounded to the nearest 100 acre-feet.

SOURCE: HUMBOLDT RIVER BASIN FIELD PARTY.

4. Can vegetal manipulation be used to increase water supply for beneficial use?

The sub-basin was divided into five separate drainages which discharge directly into the Humboldt River. They are: (1) South Fork of the Humboldt River; (2) Rabbit Creek; (3) Lamoille; (4) Starr Creek (Boulder Creek); and (5) Willow Creek.

South Fork of the Humboldt River

It was necessary to divide the South Fork of the Humboldt River into eight watersheds in order to obtain a more accurate estimate of water yield, water uses and losses. As shown by the flow diagram in figure 2 the watersheds are: (1) Upper Huntington Creek; (2) East Huntington Creek; (3) West Huntington Creek; (4) Smith Creek; (5) Upper South Fork; (6) Tenmile Creek; (7) Dixie Creek; and (8) Lower South Fork Bottom.

Stream gage records used to check the water balance studies are as follows:

1. South Fork of the Humboldt near Elko, 57 years of record.

2. South Fork of the Humboldt above Dixie Creek, 13 years of record.

3. Huntington Creek near Lee, 13 years of record.

4. South Fork of the Humboldt near Lee, 5 years of record.

In order to obtain a water balance for the watersheds discharging into Huntington Creek, using a precipitation pattern that seemed reasonable for the area, it was necessary to investigate the geology of the Ruby Mountains south of Harrison Pass. The geology indicated the possibility for movement of ground water to springs along the east base of the range (see the Geology section in this report). Inasmuch as this condition exists throughout approximately two-thirds the width of the southern Ruby Mountains, it was assumed that 80 percent of the gross water yield in this area was lost from the Humboldt Basin through this formation. The discharge from the Upper and East Huntington Creek watersheds was reduced by 10,200 acre-feet by this assumption.

The results of the Water Balance Studies indicated the following:

1. The 80 percent gross water yield (surface and subsurface) from the watersheds in the South Fork drainage is estimated to be 96,770 acre-feet annually. Assumed inflow from Rabbit Creek into Tenmile Creek watershed through springs was about 730 acre-feet. This inflow was not included in the gross water yield.

2. The estimated surface and ground water use and discharge was as follows: Irrigated crops, 27,920 acre-feet; phreatophytes, 8,720 acre-feet; loss from the Humboldt River Basin, 10,200 acre-feet; discharge to the Humboldt River, 50,660 acre-feet.

3. The Upper South Fork watershed yielded the greatest volume of water, and the watershed with the highest yield per acre, by elevation zones, was Tenmile Creek.

4. Phreatophytes of low economic value such as cottonwood, willow, wild rose, greasewood, rabbitbrush, and saltgrass use an estimated 7,430 acre-feet of ground water annually.

Lamoille Drainage

It was necessary to divide this drainage into three watersheds in order to obtain a more accurate estimate of water yield, uses and losses. As shown in the flow diagram, figure 1, these watersheds include: (1) Upper Lamoille Creek; (2) Lamoille; and (3) Secret-Soldier Creek. The Lamoille watershed includes all of Lamoille Valley bottomland and such drainages as Lamoille, Talbot, Conrad, Thorpe and John Day.

Upper Lamoille Creek watershed, which is gaged above all irrigation, has 24 years of streamflow records. This drainage was used as a trial watershed for developing water balance data in the Ruby Mountains. Other stream gage readings used to check the water balance studies consisted of 12 years of measurements taken weekly during the irrigation season on both Talbot and Thorpe Creeks.

The results of the water balance studies indicated the following:

1. The 80 percent gross water yield (surface and subsurface) from the watersheds draining into Lamoille Valley was estimated to be 73,450 acre-feet.

2. The estimated surface and ground water use and discharge was as follows: Irrigated crops, 36,090 acre-feet; phreatophytes, 4,740 acre-feet; diversion to Rabbit Creek, 160 acre-feet; and discharge to the Humboldt River, 32,460 acre-feet.

3. The greatest yield-per-acre drainage, by elevation zones, was Upper Lamoille Creek. Warm Springs, a tributary of John Day Creek, has a continuous flow of about five cubic-feet per second.

4. Phreatophytes of low economic value use an estimated 4,550 acre-feet of ground water annually.

Rabbit Creek Drainage

This drainage was treated as a single watershed. Stream gage readings used to check the water balance studies consisted of 12 years of measurements taken weekly in Seitz Canyon during the irrigation season. These records could only be used as an indication of the annual water yield.

The results of the water balance studies indicated the following:

1. The 80 percent gross water yield was estimated to be 5,360 acre-feet annually.

2. The estimated surface and ground water use and the discharge to the Humboldt River was as follows: Irrigated crops, 4,120 acre-feet; phreatophytes, 650 acre-feet; assumed lost as ground water from Tenmile Creek, 730 acre-feet; and discharge to the Humboldt River, 20 acre-feet.

3. Seitz Canyon, in the headwaters of Rabbit Creek, is one of the highest yield-per-acre areas, by elevation zones, in the sub-basin.

4. Phreatophytes of low economic value use an estimated 650 acre-feet of ground water annually.

Starr Drainage

This group of drainages was treated as a single watershed. It includes all the drainages north of Secret Creek through Herder Creek. Stream gage readings used to check the water balance studies consisted of 12 years of measurements taken weekly during the irrigation season on such streams as Herder, Ackler, East and West Boulder Creeks, and 11 years of U.S.G.S. records on Starr Creek (Boulder). The data could only be used as a indication of the annual water yield.

The results of the water balance studies indicated the following:

1. The 80 percent gross water yield, surface and subsurface flow, was estimated to be 30,710 acre-feet annually.

2. The estimated surface and ground water use and the discharge to the Humboldt River was as follows: Irrigated crops, 12,530 acre-feet; phreatophytes, 1,170 acre-feet; discharge to the Humboldt River, 17,010 acre-feet.

3. The water yield per acre, by elevation zones, is uniform throughout the watershed; however, East Boulder Creek, having the largest drainage area, yields the most water.

Table 16 -- Precipitation gaging stations within the Ruby Mountains Sub-Basin

Station		Elevation (feet)	Year of Record	Average annual precipitation (from record) (inches)
1. Elko	1/	5,075	92	8.62
2. Halleck	1/	5,229	33	8.08
3. Wells	1/	5,633	55	9.72
4. Deeth	1/	5,343	10	9.74
5. Seventy-One Ranch		5,550	14	11.17
6. Lamoille Power House		6,290	45	17.59
7. Jiggs		5,450	51	12.07
8. Sadler Ranch	2/	5,690	13	7.67
9. Overland Pass	2/	6,789	13	9.80
10. Harrison Pass	2/	7,300	14	16.87
11. Lamoille Canyon	2/	7,400	2	31.79
12. Soldier Creek	2/	7,200	12	16.15
13. American Beauty	2/	8,000	4	23.82
14. Angel Lake	2/	8,300	3	26.93

1/ Adjacent to the sub-basin.

2/ Storage gage stations.

SOURCE: U. S. WEATHER BUREAU

4. Phreatophytes of low economic value use an estimated 1,110 acre-feet of ground water annually.

Willow Creek Drainage

This group of drainages was treated as a single watershed. It includes all the streams north of Herder Creek that head in the East Humboldt Range and discharge into the Humboldt River. It includes such streams as Grey's, Trout, and Willow Creeks. There were no stream flow measurements made on these streams which were considered adequate for checking the water balance studies.

The Angel Lake drainage, which normally would drain into Clover Valley, has been diverted into Willow Creek. No records are available to indicate the amount of water diverted annually, and for this reason the Angel Lake drainage

Table 17 -- Snow survey measurements for the Ruby Mountains Sub-Basin (1943-1957 adjusted averages)

Snow Course	Elevation (feet)	Record began	Water content (inches) March	April
1. Lamoille No. 1	7,100	1922	9.8	10.6
2. Lamoille No. 2	7,200	1922	9.4	10.3
3. Lamoille No. 3	7,700	1935	12.2	13.8
4. Lamoille No. 4	8,000	1940	17.7	20.4
5. Lamoille No. 5	8,700	1935	25.2	29.6
6. Harrison Pass No. 1	6,600	1919	4.0	2.8
7. Harrison Pass No. 2	7,400	1930	4.4	3.6
8. Green Mountain	8,000	1935	11.2	13.8
9. Corral Canyon	8,500	1935	16.5	21.1
10. Cave Creek 1/	7,500	1940	13.1	14.1
11. Hager Canyon 1/	8,000	1940	17.1	20.4
12. Dry Creek	6,500	1932	4.8	3.7
13. Dorsey Basin	8,100	1932	10.2	14.9
14. Ryan Ranch	5,800	1932	2.0	1.1
15. Trout Creek, Upper	8,500	1935	19.0	24.9
16. Trout Creek, Lower	6,900	1935	4.7	1.9

1/ East slope of Ruby Mountains.

SOURCE: THE NEVADA COOPERATIVE SNOW SURVEY SUMMARY, 1910-1961

was included as part of the Willow Creek watershed to obtain the gross water yield. The flow diagram, figure 1, indicates the inflow from Angel Lake but does not show a quantity.

The results of the water balance studies indicated the following:

1. The 80 percent gross water yield (surface and subsurface) from the watershed was estimated to be 8,070 acre-feet annually.

2. The estimated surface and ground water use and the discharge to the Humboldt River was as follows: Irrigation, 7,080 acre-feet; phreatophytes, 480 acre-feet; and discharge to the Humboldt River, 510 acre-feet.

3. The water yield, by elevation zones, from the different drainages in this watershed is fairly uniform.

4. Phreatophytes of low economic value use an estimated 480 acre-feet of water annually.

WILDLIFE MANAGEMENT

Fisheries Management

Current Management Practices on Ruby Mountain Waters

Basic Surveys Needed

There are still several streams and at least two lakes which have not had basic surveys of their physical, chemical and biological properties. Until these surveys can be completed, no management plans can be drawn up. High priorities have been assigned to those waters accessible to the public. Several streams on the Humboldt National Forest which are not accessible because of locked gates have been assigned very low priority for survey.

Unsurveyed waters of the fishing lakes and streams in the Ruby Mountains Sub-Basin are as follows:

Unnamed lakes on Rattlesnake Creek and First Boulder Creek
Warm Creek
Right Fork Lamoille Creek
Heenan Creek
Stephens Creek
Starvation Creek)
Murphy Creek) Behind locked gates on 71 Ranch property
Ross Creek)
Wilson Creek)

SOURCE: NEVADA FISH AND GAME DEPARTMENT

Creel Census and Population Inventory

Fish and Game Department personnel make random creel checks on all waters to gather data on angler success in terms of fish caught per hour of effort. In case angler success declines seriously on any water, population inventories are made with a shocker on streams or with gill nets on lakes to determine what fish are actually present in terms of species, size, recruitment (propagation rate), etc.

Stocking with Catchable or Fingerling Fish

In those cases where fishing pressure is too heavy for natural propagation to maintain satisfactory rate of catch, or where natural propagation does not occur, artificial stocking is used. On waters with heavy angling pressure, catchable size fish are stocked annually or even several times during a summer. On those waters with less fishing pressure but where natural propagation is limited, occasional fingerling plants are made. This may be annually, but more often might be done in two to five years.

Waters stocked periodically or occasionally

South Fork Humboldt) Angel Lake) Lamoille Creek)	Catchable sized fish - "Put and Take" stocking
Island Lake) Hidden Lakes) Boulder Lake) Grey's Lake) Cold Lakes) Griswold Lake) Verdi Lake) Starr Creek (Boulder))	Fingerling plants to supplement natural spawning or where no natural spawning occurs.

SOURCE: NEVADA FISH AND GAME DEPARTMENT

Initial Stocking of Barren Waters

Certain waters of the Ruby Unit may have potential as fisheries but are not presently supporting fish. After surveys are completed on these waters it may be desirable to introduce fingerling trout of selected species in order to fully develop the resource. Smith Lake is an example. This water may be stocked with an introduction of California golden trout, which with Forest Service assistance were first planted in the Rubies (Cold Lakes) in the summer of 1960. There are certain streams with headwaters devoid of game fish because of natural barriers. Additional study may indicate that these waters are suitable for a certain species of trout, such as native cutthroat or California golden trout, which will thus provide a source of broodstock.

Stream Improvement

This management practice is planned for certain waters in the unit. Any work of this nature is costly and at present is only justified on those waters with relatively heavy angling pressure. It should otherwise be considered only as a remedial measure to help restore waters damaged by floods or poor watershed management. Artifical structures are a poor substitute for natural streambanks, cover, and pools found on good trout waters. At present, Lamoille Creek is under consideration for some experimental stream improvement work, on the basis of heavy fishing pressure.

Small Game Management

Native Small Game

Sage grouse - are found in all portions of this unit except the highest elevations. They are currently present in moderate numbers, and supply several days of recreation to hunters each year.

Table 18 -- List of surveyed waters - Ruby Mountain Unit, Nevada Fish and Game Department, Ruby Mountains Sub-Basin

Stream	Fishable miles	Stream	Fishable miles
Ackler Creek	5.5	Echo Canyon Creek	4.0
Boulder Creek	25.0	Box Canyon Creek	6.0
Brown Creek	2.0	Kleckner Creek	7.0
Carville Creek	3.0	Lamoille Creek	17.0
Cold Creek	6.5	Long Canyon Creek	7.0
Corral Creek	7.0	McCutcheon Creek	4.0
Cottonwood Creek	---	Pearl Creek	5.0
Deering Creek	4.5	Rattlesnake Creek	3.0
Dixie Creek	---	Secret Creek	3.0
Furlong Creek (North)	5.0	Seitz (Rabbit Creek)	2.5
Genette Creek	2.0	Smith Creek	9.0
Gilbert Creek	1.0	Soldier Creek	6.0
Green Mountain Creek	3.0	Talbot Creek	6.5
Herder Creek	4.0	Thorpe Creek	7.0
Horse Creek	1.7	Toyn Creek	5.0
Humboldt River - South Fork	20.0	Willow Creek	1.5
		Total	183.7

Lakes	Surface acres
Angel Lake	13.0
Boulder Lake	6.0
Cold Lakes	5.5
Echo Lake	29.0
Favre Lake	19.0
Grey's Lake	5.0
Hidden Lakes	9.0
Island Lake	7.5
Lamoille Lake	13.5
Liberty Lake	21.0
Verdi Lake	6.0
Smith Lake	5.0
Total	139.5

Source: Nevada Fish and Game Department

Blue grouse - occupy the higher elevations in habitat characterized by limber pine, aspen and the browse-shrub associations. They are few in numbers, and are hunted only lightly.

Mourning dove - is a migratory bird protected by Federal regulations. It is a common summer resident and nests throughout the entire area.

Waterfowl - include all the various ducks, geese and swans. They are found throughout the area on all the major streams and reservoirs.

Cottontail rabbit - is the most common small game species in the area. It is subject to violent fluctuations in numbers from year to year but is considered a major recreational resource.

Introduced Small Game

Chukar partridge - a native of India, introduced in Nevada in the 1930's, is still continuing to extend its range. Its highest population density is in the western part of the area, especially in the Dixie Creek drainage and the canyons of the lower South Fork of the Humboldt River. Important colonies of this bird are found on Grindstone Mountain, and in all drainages south of Lee on the west slope of the Ruby Mountains.

Hungarian partridge - is more widely distributed, perhaps as a result of its earlier introduction, but is nowhere abundant. Isolated coveys may be encountered anywhere, but not consistently. Lamoille and Pleasant Valleys and the Lee and Jiggs areas may well be the focal points for these scattered populations. Any increase in farmland type crops such as small grains would be beneficial to the "hun".

Valley quail - were introduced in Pleasant Valley in April 1961 and have apparently increased and dispersed in a very encouraging manner. Further introductions into suitable habitat are contemplated as additional release stock becomes available. Although these birds might be eliminated by an occasional severe winter, the relatively low cost of reintroduction with wild-trapped birds may well justify their management in this unit.

Mountain quail - occur naturally in other areas of Elko County and may well be suited for introduction in this unit. Experimental releases are planned when and if a source of supply is located.

Ruffed grouse - possibilities have been investigated for Soldier Creek Canyon. Habitat investigations in South Idaho in the Pocatello area have shown remarkable simularity to portions of the Ruby Unit. A number of these birds have been promised by the Idaho Fish and Game Department and will be released in Soldier Creek upon their delivery.

Ring-necked pheasant - are receiving very little consideration at the present time. A small nucleus population has been present in the Lamoille and Pleasant Valley areas for many years. This population is maintaining itself but shows no increase. Apparently it will always be limited to the cropland agriculture of these areas. There is little potential for hunting these birds in this area.

Himalayan snow cock - in April 1963, with the consent of the Forest Service, approximately 35 of these birds will be planted, for the first time in the United States, around Robinson Lake and the Hidden Lakes. This species, resembling a large chukar partridge (three to six pounds), lives at altitudes from 8,000 to 18,000 feet in its native habitat - the Himalaya, Hindu Koosh and Karakorem Ranges, north of India and Pakistan. It is hoped that the bird will do well in the high country of the Rubies, where environmental conditions are quite similar to those of its home range.

FOREST SERVICE REGION FOUR
CHANNEL CONDITION CLASSIFICATION CRITERIA

The following describes a method of classifying the condition of perennial or intermittent stream channels. Channel condition, as used here, is measured by indicators of channel stability. Classification is not based on any one factor; all the criteria must be weighed before a decision is reached.

Class 1 - Good

1. Channel sides well vegetated.
2. No slumping of channel sides.
3. Very little or no cutting or deposition of channel bottom.
4. Aquatic vegetation on channel sides and bottom.
5. Algae on rocks.
6. Very little or no recent cutting or deposition along channel sides.

Class 2 - Fair

1. Channel sides partially vegetated.
2. Slumping of channel sides at constrictions and bends.
3. Some cutting of channel bottom at constrictions, bends and steep grades and deposition in areas where the water velocity is less, e.g. pools.
4. Aquatic vegetation scattered, mostly in areas where stream velocities are low.
5. Algae on rocks in places where the bottom is stable.
6. Some cutting of stream banks at constricted areas or at outside of bends; deposition at the inside of bends and at the confluence with other streams.

Class 3 - Poor

1. Very little vegetation on channel sides.
2. Slumping of channel sides common.
3. Cutting and deposition of channel bottom common, bottom obviously in a state of flux.
4. No aquatic vegetation.
5. No algae on rocks.
6. Large-scale cutting of stream banks common.

Channels in Rock

In some instances, the channel cross section may be carved in rock. In this case, some of the factors listed under the Fair or Poor class may be in evidence, e.g., lack of vegetation on banks and deposition at grade changes. In order to classify the condition of such channels on the basis of channel stability, they must be considered to be in the Good condition class.

APPENDIX II

This appendix is produced in a relatively limited number of copies. It contains material germane to the Ruby Mountains Sub-Basin but which, because of its detailed or technical nature, is not attached to copies for general distribution.

Such material, however, has potential value as an information reservoir for technicians, administrators, and resource managers concerned with the Ruby Mountains Sub-Basin.

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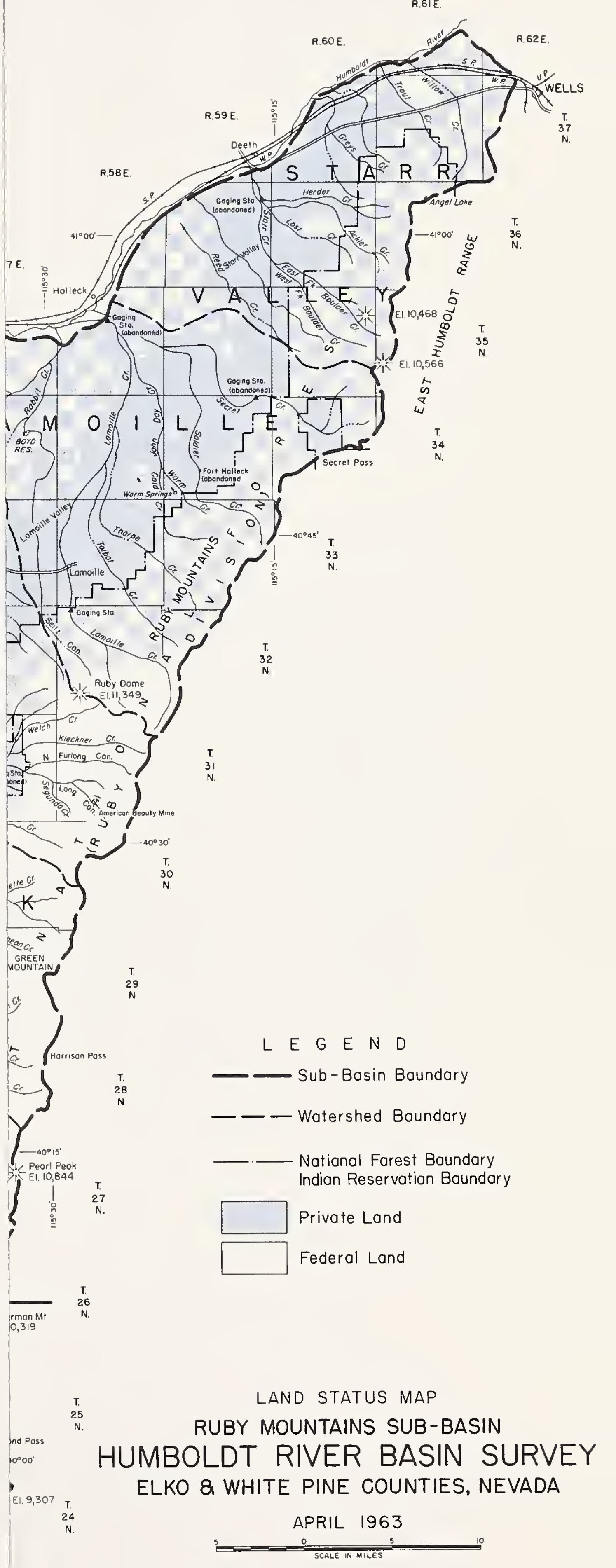
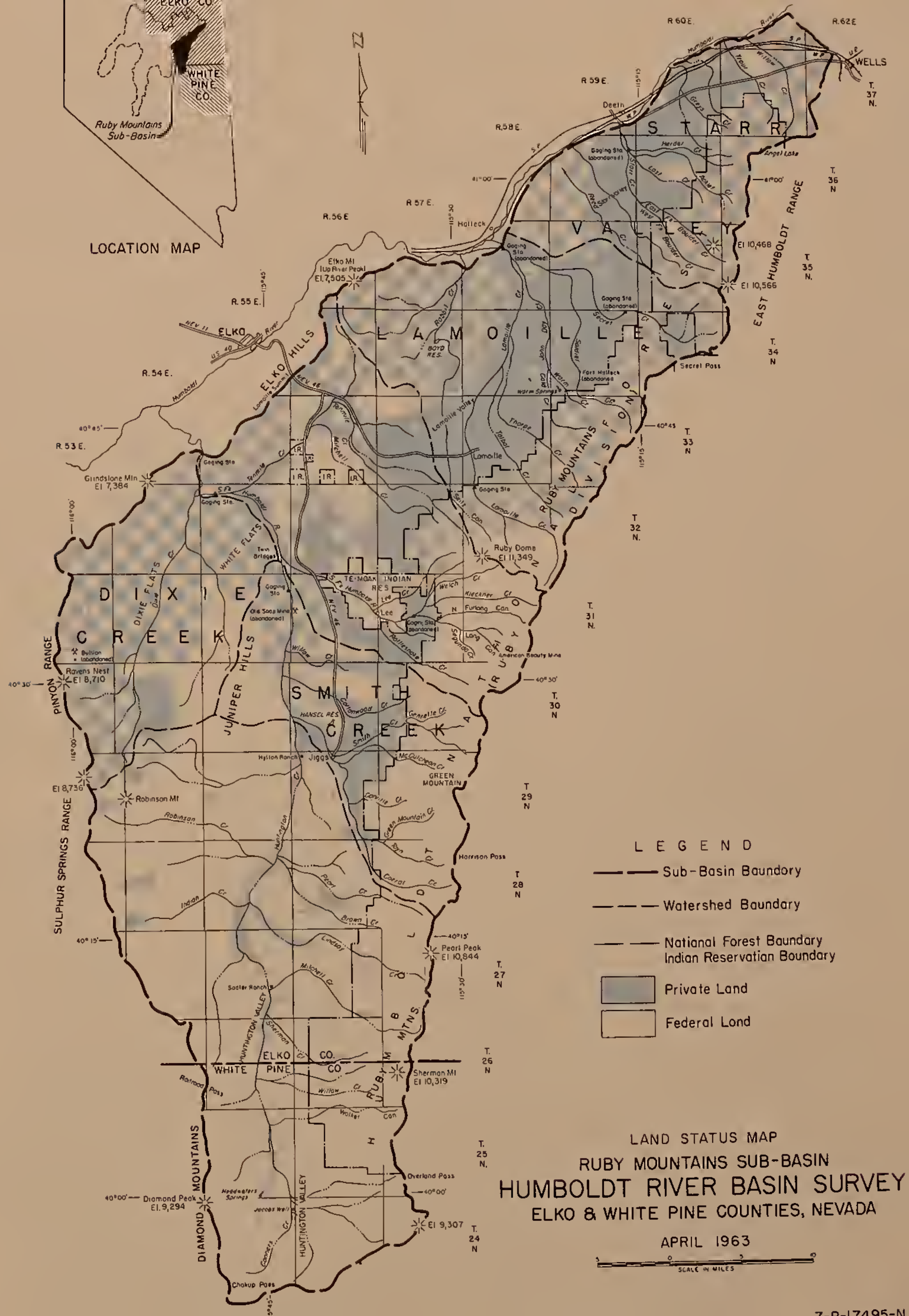


LAND STATUS MAP
RUBY MOUNTAINS SUB-BASIN
HUMBOLDT RIVER BASIN SURVEY
ELKO & WHITE PINE COUNTIES, NEVADA
APRIL 1963



LAND STATUS MAP
RUBY MOUNTAINS SUB-BASIN
HUMBOLDT RIVER BASIN SURVEY
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APRIL 1963

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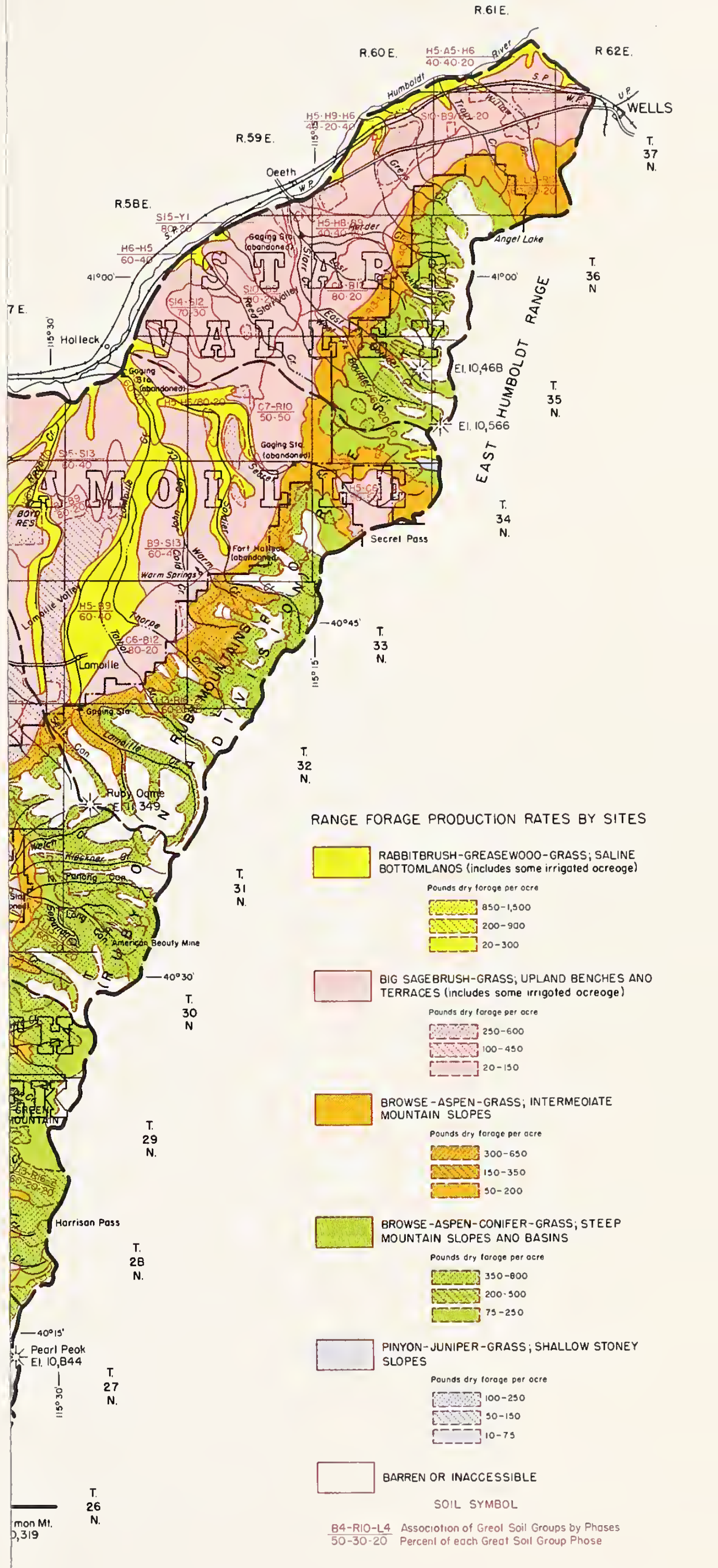


SOILS, RANGE SITES, AND FORAGE PRODUCTION

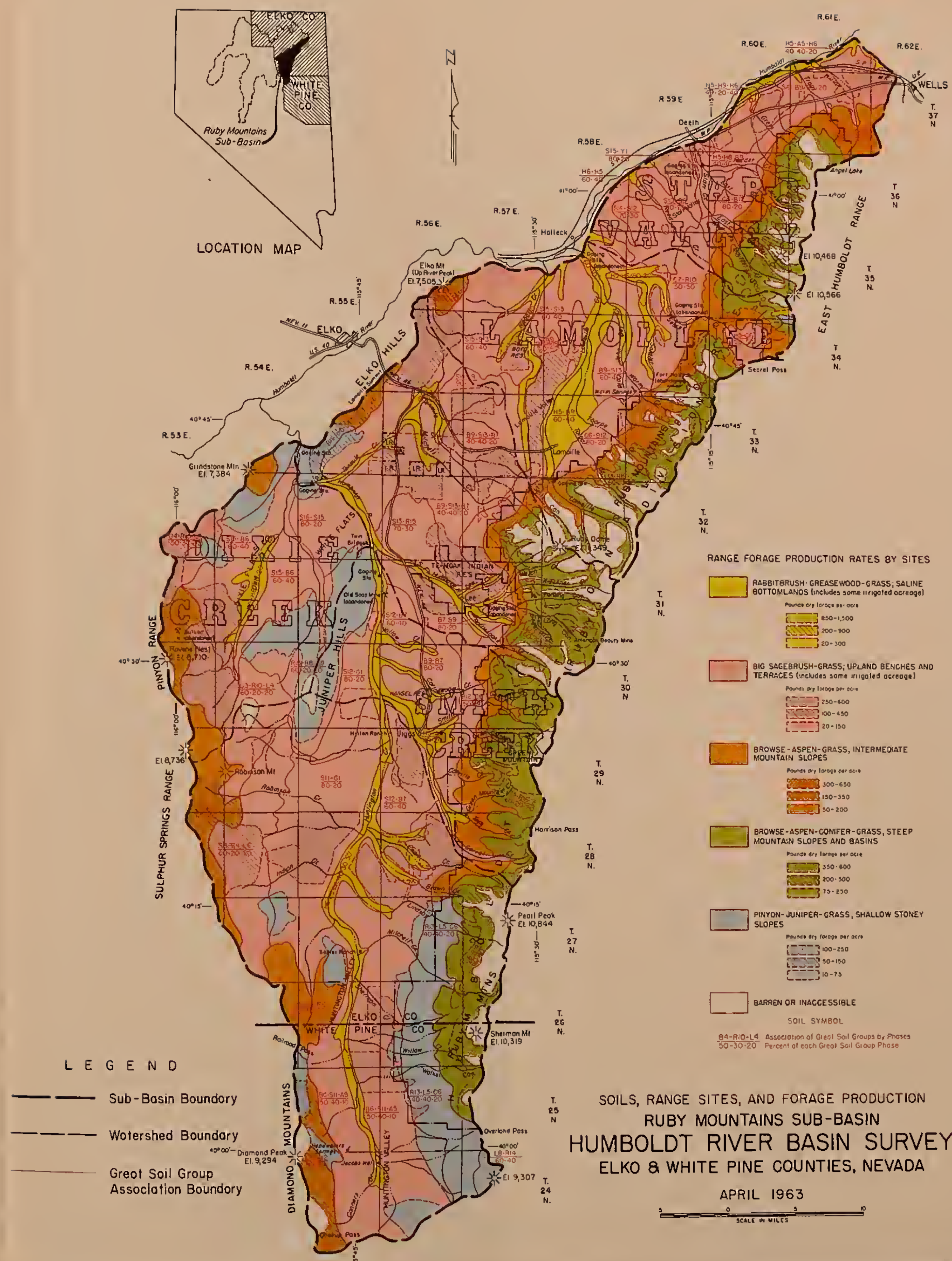
RUBY MOUNTAINS SUB-BASIN

HUMBOLDT RIVER BASIN SURVEY

ELKO & WHITE PINE COUNTIES, NEVADA

APRIL 1963

SCALE IN MILES



SOILS, RANGE SITES, AND FORAGE PRODUCTION
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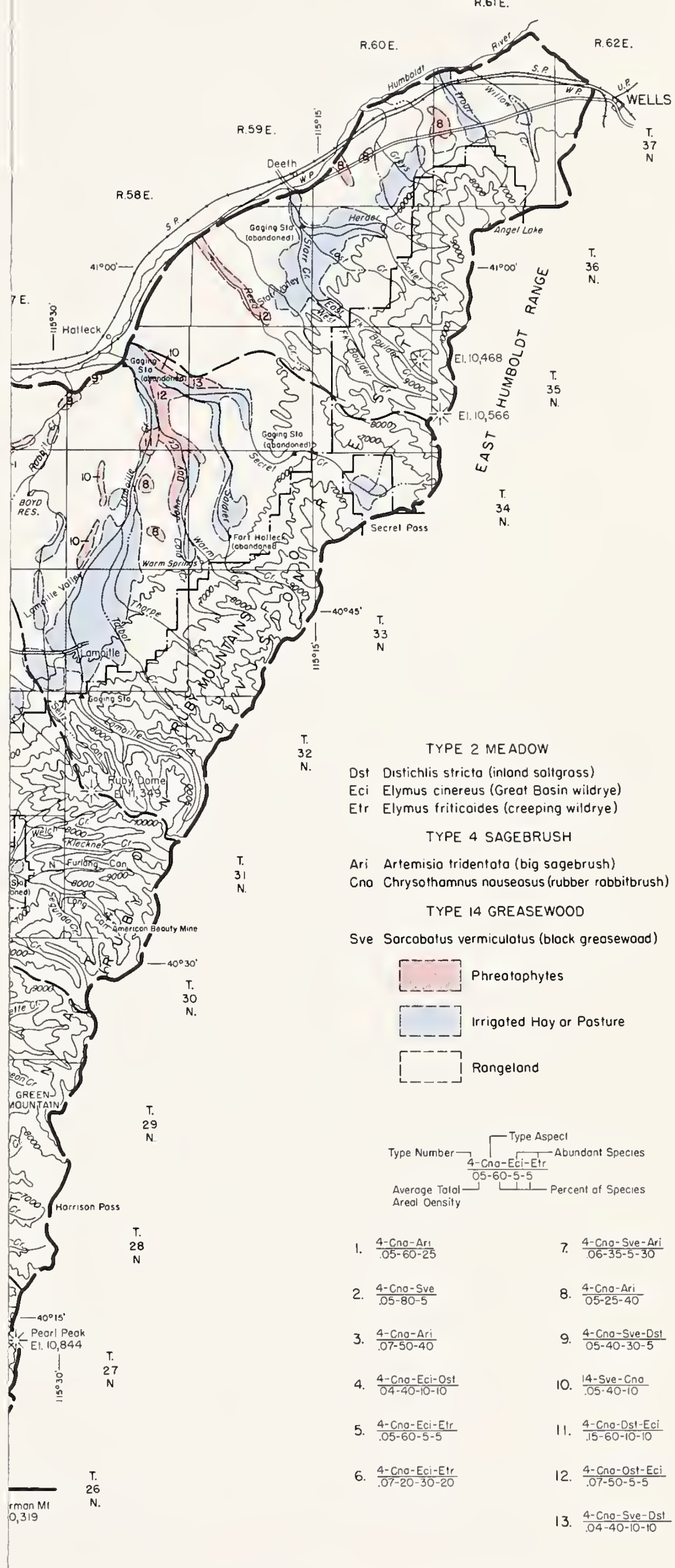


LAND USE AND PHREATOPHYTE MAP

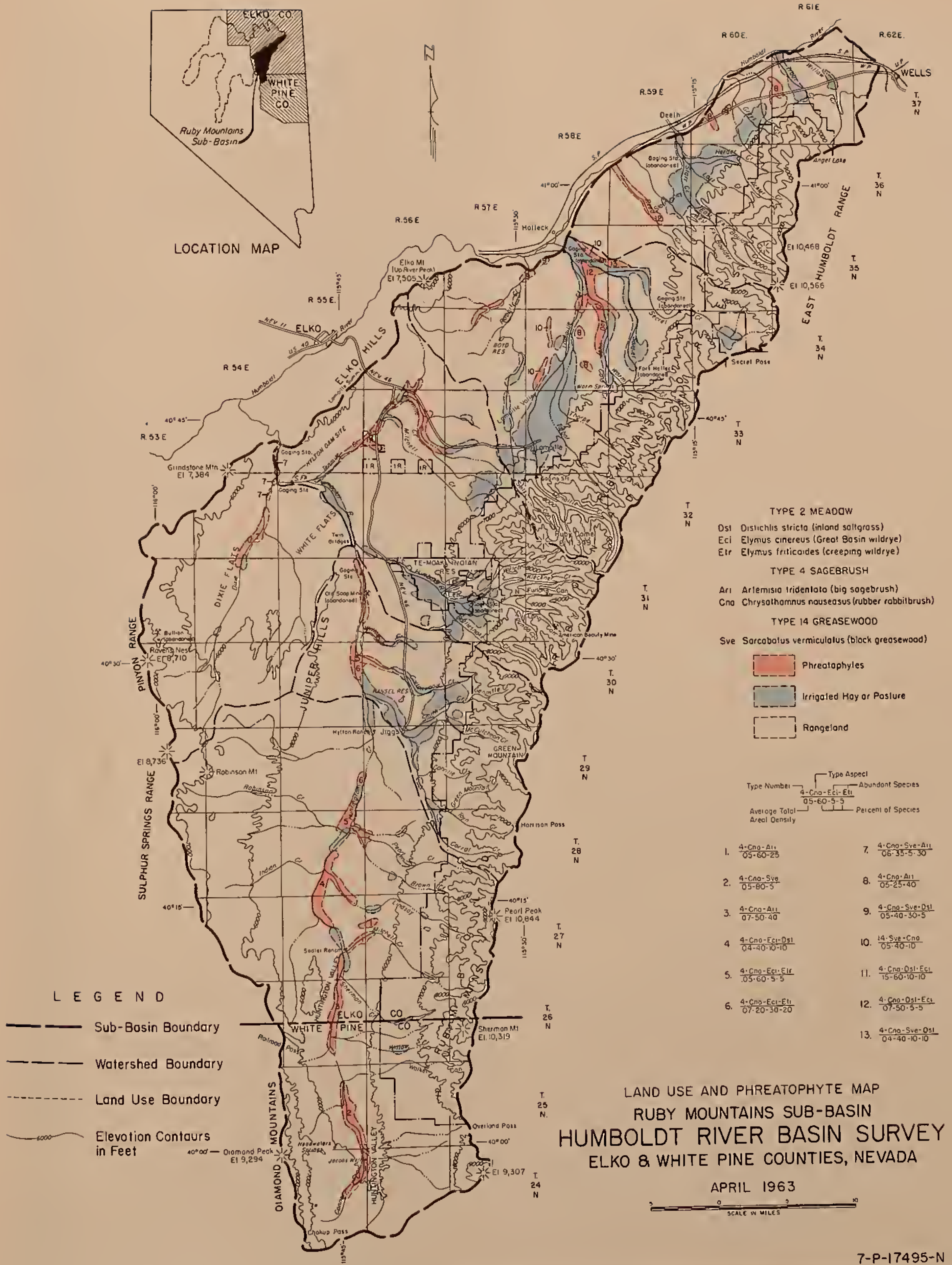
RUBY MOUNTAINS SUB-BASIN

HUMBOLDT RIVER BASIN SURVEY

ELKO & WHITE PINE COUNTIES, NEVADA

APRIL 1963

SCALE IN MILES



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